1866797

STATE OF COLORADO

For Agency Use Only
Permit Number Assigned ______
Date Received ____/____/____ Month Day Year

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department of Public Health and Environment

COLORADO DISCHARGE PERMIT SYSTEM (CDPS)

INDUSTRIAL INDIVIDUAL WASTEWATER DISCHARGE PERMIT

Please print or type. Original signatures are required. All items must be completed accurately and in their entirety for the application to be deemed complete. Incomplete applications will not be processed until all information is received which will ultimately delay the issuance of a permit. If more space is required to answer any question, please attach additional sheets to the application form. Applications must be submitted by certified mail or hand delivered to:

Colorado Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive South WQCD-P-B2
Denver, Colorado 80246-1530

PHOTO COPIES, FAXED COPIES, PDF COPIES OR EMAILED COPIES WILL NOT BE ACCEPTED.

This application is for use by all **individual industrial process water dischargers to surface water, ground water or stormwater dischargers**. Discharges to ground water may occur from impoundments that are either non-discharging to surface water or discharging to surface water, land application and septic systems, whose design capacity is greater than 2000 gallons per day. The Division has industry specific permits for construction dewatering, sand and gravel, gasoline clean up sites or other groundwater remediation, hydrostatic testing, subterranean dewatering, water treatment plants, hardrock mining, coal mining, non-contact cooling water, aquatic animal production, produced water from oil and gas facilities, commercial washing of outdoor structures, along with several for stormwater only discharges. If the facility falls under one of these activities, please check the website for the appropriate application (www.coloradowaterpermits.com – click on the industrial link).

PERMIT INFORMATION

Reason for Application: ☒ NEW PERMIT
☐ RENEW PERMIT   EXISTING PERMIT #__________

Discharge is to ☐ Surface Water ☐ Ground Water ☒ Both

Applicant is: ☐ Property Owner ☒ Contractor/Operator

1. **Permit Applicant Legal Contact Address and Contact Information**

Company Name Atlantic Richfield Company
First Name Chuck Last Name Stilwell
Title Remediation Manager
Mailing Address BP Exploration Alaska, 900 E. Benson Blvd.
City, State and Zip Code Anchorage, AK 99508
Phone (907) 564-4608 Fax________ Cell (406) 491-1129
E-mail Address Chuck.Stilwell@bp.com

2. Other Contact Information

Owner ☒ Same as Applicant

Company Name ______
First Name ______ Last Name ______
Title ______
Mailing Address ______
City, State and Zip Code ______
Phone ______ Fax ______ Cell ______
E-mail Address ______

Operator ☒ Yes We have a Certified Operator ☐ Same as Applicant

Company Name To be determined
First Name ______ Last Name ______
Title ______
Mailing Address ______
City, State and Zip Code ______
Phone ______ Fax ______ Cell ______
E-mail Address ______
Certification Number ______ Certification Level ______

Facility Contact ☐ Same as Applicant

Company Name To be determined
First Name ______ Last Name ______
Title ______
Mailing Address ______
City, State and Zip Code ______
Phone ______ Fax ______ Cell ______
E-mail Address ______
Is the Facility/Site Address and Contact the DMR Mailing Address and Contact? ☒ YES ☐ NO

DMR Mailing Address and Contact ☒ Same as Applicant

Company Name ______
First Name ______ Last Name ______
Title ______
Mailing Address ______
City, State and Zip Code ______
Phone ______ Fax ______ Cell ______
E-mail Address ______

If more spaces are needed, please add additional pages

Billing Address and Contact ☒ Same as Applicant

Company Name ____

First Name ____ Last Name ____

Title ____

Mailing Address ____

City, State and Zip Code ____

Phone ____ Fax ____ Cell ____

E-mail Address ____

Assignment of Authorized Agent Regulation 61 [61.4(1)]

In accordance with Regulation 61, all reports required by permits and other information requested by the Division shall be signed by a person described in section 61.4(1)(e) or by a duly authorized representative of that person. A person is a duly authorized representative only if:

i. The authorization is made in writing by a person described in paragraph 61.4(1)(e);
ii. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a **named individual** or any individual occupying a **named position**); and,
iii. The written authorization is submitted to the Division.

Duly Authorized Representative information provided below? ☐ NO ☒ YES

Authorized Agent Chuck Stilwell Email Address Chuck.Stilwell@bp.com

Title Remediation Manager Telephone No. (406) 491-1129

Authorized Position ____ Telephone No. ____

Currently held by ____ Email Address ____

3. **Permitted Facility Information**

- Facility Name Atlantic Richfield, St. Louis Tunnel

Type of Facility Ownership

☐ City Government ☐ Corporation ☒ Private ☐ Municipal or Water District

☐ State Government ☐ Mixed Ownership ____

- **Facility/Site Location**

Street Address ____

City, State and Zip Code Rico, Colorado 81332

County Dolores

Legal Description

SW1/4 of the SW 1/4 of Section 24 and NW1/4 of the NW1/4, NE1/4 of the NW1/4, SW1/4 of the NW1/4, SE1/4 of the NW1/4 and NW1/4 of the SW1/4 of Section 25, T40N, R11W

Directions

.75 miles north of the northern boundary of the Town of Rico

Latitude (Dec.Deg) ____ Longitude (Dec.Deg.) ____

Horizontal Collection Method: ☐ GPS Unspecified ☐ Interpolation – Map Map Scale Number ____

Reference Point : ☐ Facility Entrance ☐ Facility Center/Centroid

3. **Permitted Facility Information continued**

- **Facility Industry Classification Codes (Use SIC)**

  Primary 1031 (inactive) Secondary__________ Secondary__________ Secondary__________

- **Facility Industrial/Business Activity**

  Describe the primary industrial and/or business activities which take place on site. If this is a seasonal operation, list the months of operation:

This facility is an inactive underground lead, zinc and silver mine that has not been operated actively since 1983. The only "industrial" activity that will be conducted on site will be the operation of a lime treatment and settling system for the discharge of the St. Louis Tunnel. (See Attachment 14)

- **Production:** List the principal product(s) produced and maximum production rate.

NA

- **Intermittent Discharges**

  A discharge is intermittent unless it occurs without interruption during the operating hours of the facility, except for maintenance, process change or similar shutdown. A discharge is seasonal if it occurs only during certain parts of the year.

  Except for storm runoff, are any discharges intermittent or seasonal? ☐ YES ☒ NO

  Describe the frequency, duration, and flow rate of each discharge occurrence, except for storm runoff, spillage, or leaks:

Average treated effluent flow rate to the Dolores River = 1.53 MGD. Flow rate varies seasonally - see Attachment 15, 2008 Water Quality Assessment, for more information.

- **Location Map :** A location map designating the facility property, intake points, discharge points, each of its hazardous waste treatment storage or disposal facilities, each well where fluids from the facility are injected underground, those wells, springs, other surface water bodies and drinking water wells listed in public records or otherwise known to the applicant and the receiving waters shall be submitted. The map shall extend one mile beyond the property boundaries. The map shall be from a 7☐ or 15 minute USGS quad sheet, or a map of comparable scale. A north arrow shall be shown. **The map must be on paper 8.5 x 11 inches.**

- **Site sketch:** A legible sketch of the facility site shall be submitted and will include buildings, roads, ditches, ponds, streams, drains, sumps, impoundment(s), land application areas, any septic systems and monitoring well locations (indicate if in place or proposed). This sketch may be the same as the one in the surface water discharge permit, if no additional information is needed. **The sketch will be on 8.5 X 11 inch paper.**

- **Water Balance:** Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in item 18. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined, provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

3. **Permitted Facility Information continued**

- **Site-specific conditions:**

    a) Does this facility have bulk storage of diesel fuel, gasoline, solvents, fertilizers, or other hazardous materials on site? ☒ NO ☐ YES

    b) Is this operation located within one mile of a landfill, or any mine or mill tailings? ☐ NO ☒ YES

    If **YES for either** of these, please show location of landfill, tailings, or possible groundwater contamination on the **Location Map or in the Site Sketch** (See above requirements). Please explain the location, extent of contamination, possible effect on the discharges from this facility.

- **Chemical treatment:** Will any flocculants (settling agents or chemical additives) be used to treat water prior to discharge? ☐ NO ☒ YES

If YES, list here and include the Material Safety Data Sheet (MSDS) with the application.

Chemical Name *	Manufacturer	Purpose	In Which Waste Stream?
Hydrated lime	TBD	pH/ precipitation of solids	St. Louis Tunnel effluent

* If the chemical formula is unknown or confidential, provide the manufacturer's name, contact person, address and phone number or a copy of the manufacturer's brochure, product label information or materials handling data sheet for each product used. Please list the major constituents or active ingredient(s), if known.

- **Used of Manufactured toxics:** The applicant must provide a list of any constituents listed in Appendices A and B which the applicant currently uses or manufactures as an intermediate or final product or by-product. If any constituents are known to be used or manufactured and are not identified in Appendices A and B, list those as well:

NA

- **Flow measurement:** What method of flow measurement will be used for each discharge point (e.g., v notch weir, pump capacity, parshall flume, etc.)? Designate whether currently installed or proposed. Identify the minimum and maximum flow measurement capability.

Influent to pond system and final outfall both have existing 9" Parshall flumes for flow measurement - the influent flume will be replaced prior to start-up of lime treatment system. The theoretical measurement range for both flumes is 0.9 cfs to 5.65 cfs.

- **Improvements:** Please provide a description of any abatement requirement, abatement project and projected final compliance dates if subject to any present requirements or compliance schedules for construction, upgrading or operation of waste treatment equipment. Also include here a description of any changes to the facility since the previous permit renewal.

See Attachment 6 for proposed construction and operation schedule for lime treatment system.

3. **Permitted Facility Information continued**

- **Ground Water Discharge:** Indicate whether this facility has any of the following:
  - Land Application (disposal/treatment) ☒NO ☐YES
  - Impoundment (pond/lagoon) ☐NO ☒YES
  - Septic System for
    - Industrial Waste ☒NO ☐YES
    - Domestic Waste ☒NO ☐YES

- **Average flows and treatment:** Please provide a narrative identification of each type of process, operation, or production area which contributes wastewater to the effluent for each outfall including process wastewater, cooling waters, domestic wastewater and stormwater runoff; the average, maximum and design flow which each process contributes; and a description of the treatment the wastewater receives including the ultimate disposal of any solid or fluid wastes other than by discharge. Processes, operations or production areas may be described in general terms. The average flow of point sources composed of stormwater may be estimated. The basis for the rainfall event and the method of estimation must be indicated.

Use additional pages as needed

OUTFALL NUMBER	WASTEWATER SOURCE	TREATMENT USED	AVG FLOW MGD*	DESIGN ** FLOW MGD*	DAILY MAX FLOW MGD*
001	See Attachment 7 and				
	Table A-6 in WQA				

*MGD - Million gallons/day
**If sediment pond, indicate approximate volume of water.

For each outfall to surface water or discharge to ground water, provide latitude/longitude and receiving water

OUTFALL	LATITUDE			LONGITUDE			RECEIVING WATERS*
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	* Give Formation Name for Discharges to Ground Water
001	37	42	03	108	01	50	Dolores River

Are the receiving waters, indicated above, a ditch or storm sewer? ☒ NO ☐ YES
If YES, submit documentation that the owner of the ditch or storm sewer allows this discharge. No permit will be processed unless documentation of approval is received.

Discharge Quality: Analytical data for the following parameters, unless waived by the Division, shall be submitted from at least one composite sampling of each surface process water discharge point as well as state waters upstream of each discharge. Instream sampling is not required if upstream flow is intermittent or representative instream data exists. See instructions. For **GROUND WATER** analyses see Appendices D and E1-3.

PARAMETER	DETECTION LEVEL	PARAMETER	DETECTION LEVEL
Total Dissolved Solids, mg/P	10	Total Recoverable Manganese, mg/l	0.05
Flow, MGD	NA	Dissolved Manganese, mg/l	0.05
pH, s.u.	NA	Total Mercury, mg/l	0.00025
Oil and Grease, mg/l	5	Total Recoverable Nickel, mg/l	0.05
Dissolved Oxygen, mg/ l	NA	Potentially Dissolved Nickel, mg/l	0.05
Alkalinity, mg/ l	10	Total Recoverable Silver, mg/l	0.0002
Total Suspended Solids, mg/ l	10	Potentially Dissolved Silver, mg/l	0.0002
Hardness, mg/ l as $CaCO_3$	10	Total Recoverable Uranium, mg/l	0.03
Total Ammonia, mg/ l as N	0.05	Total Recoverable Zinc mg/l	0.05
Temperature, ^{B}C Winter	NA	Potentially Dissolved Zinc, mg/l	0.05
Temperature, ^{B}C Summer	NA	Total Residual Chlorine, mg/l	0.05
Biochemical Oxygen Demand, mg/ l	1	Fecal Coliform, #/100 ml	NA
Chemical Oxygen Demand, mg/ l	30	Nitrate, mg/l as N	0.1
Dissolved Aluminum, mg/ l	0.1	Nitrite, mg/l as N	0.002
Total Arsenic, mg/l	0.05	Sulfide mg/l as H_2S	0.1
Total Recoverable Cadmium, mg/l	0.0004	Boron, mg/l	0.05
Hexavalent Chromium, mg/l	0.025	Chloride, mg/l	5
Trivalent Chromium, mg/l	0.05	Sulfate, mg/l	5
Total Chromium, mg/ l	0.005	Total Cyanide, mg/l	0.01
Total Recoverable Copper, mg/ l	0.005	Total Recoverable Selenium, mg/l	0.002
Potentially Dissolved Copper, mg/l	0.005	Total Cobalt, mg/l	0.006
Total Recoverable Iron, mg/l	0.3	Gross Alpha, piC/l	0.3
Dissolved Iron, mg/l	0.3	Total Radium 226 + 228, pCi/l	8
Total Recoverable Lead, mg/l	0.005	Total Fluoride, mg/l	0.1
Potentially Dissolved Lead, mg/l	0.005	Weak Acid Dissociable Cyanide, mg/l	0.01
Total Phenols, mg/l	0.100	Total Phosphorus, mg/l	0.05
Total Organic Nitrogen, mg/l	1.0		

Dioxin Testing: Each applicant must report qualitative data, generated using a screening procedure not calibrated with analytical standards, for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) if it:

(a) Uses or manufactures 2,4,5-trichlorophenoxy acetic acid (2,4,5,-T); 2-(2,4,5-trichlorophenoxy) propanoic acid (Silvex, 2,4,5,-TP); 2-(2,4,5-trichlorophenoxy) ethyl, 2,2-dichloropropionate (Erbon); O,O-dimethyl O-(2,4,5-trichlorphenyl) phosphorothioate (Ronnel); 2,4,5-trichlorophenol (TCP); or hexachlorophene (HCP);

or

(b) Knows or has reason to believe that TCDD is or may be present in an effluent.

Whole Effluent Toxicity Testing and Priority Pollutant Scan for Surface Discharge Points

If you have processes in one of the following industries you must also submit the analyses specified below by a "X" in the corresponding box. The parameters for the appropriate GC/MS fraction(s) are shown in Appendix A to this application (see 40 CFR Part 122, Appendix D Table 1 for testing requirements and additional information for these specific industries). The WET testing shall be conducted on 100% effluent and be for both Ceriodaphnia dubia and fathead minnows. This requirement is waived where routine testing is currently required under an existing CDPS permit. The test shall be an acute test unless the ratio of stream low flow to effluent design flow is less than 10:1, respectively, and the receiving stream has a Class 1 or Class 2 Aquatic Life use with all the appropriate aquatic life numeric standards. In the latter case a chronic test is required. The Division reserves the right to request WET testing on industries not listed below or to request additional testing as part of the application review process. If so required, the permit application will not be considered complete until the additional information is submitted.

INDUSTRY CATEGORY	WET TESTING	GC/MS FRACTION			
		VOLATILE	ACID	NEUTRAL	PETICIDE
Adhesives and sealants	X	X	X	X	
Aluminum forming	X	X	X	X	
Auto and other laundries	X	X	X	X	X
Battery manufacturing	X	X		X	
Coil coating	X	X	X	X	
Copper forming	X	X	X	X	
Electric and electronic compounds	X	X	X	X	X
Electroplating	X	X	X	X	
Explosives manufacturing	X		X	X	
Foundries	X	X	X	X	
Gum and wood (all sub parts except D and F)	X	X	X		
Subpart D--tall oil rosin	X	X	X	X	
Subpart F--rosin-based derivatives	X	X	X	X	
Inorganic chemicals manufacturing	X	X	X	X	
Iron and steel manufacturing	X	X	X	X	
Leather tanning and finishing	X	X	X	X	
Mechanical Products manufacturing	X	X	X	X	
Nonferrous metals manufacturing	X	X	X	X	X
Organic chemicals manufacturing	X	X	X	X	X
Paint and Ink Formation	X	X	X	X	
Pesticides	X	X	X	X	X
Petroleum refining	X	X			
Pharmaceutical preparations	X	X	X	X	
Photographic equipment and supplies	X	X	X	X	
Plastic and synthetic materials manufacturing	X	X	X	X	X
Plastic processing	X	X			
Porcelain enameling	X				
Printing and publishing	X	X	X	X	X
Pulp and paperboard mills	X				
Rubber processing	X	X	X	X	
Soap and detergent manufacturing	X	X	X	X	
Steam electric power plants	X	X	X	X	
Textile mills (subpart C--Greige Mills are exempt from this table)	X	X	X	X	
Timber products processing	X	X	X	X	X
Landfills	X	X	X	X	X
Oil and gas extraction-- produced water	X	X	X	X	
Sugar processing	X	X	X	X	X
Oil Shale	X	X	X	X	

Additional monitoring:

The applicant must review Appendices A and B and must indicate whether it knows or has reason to believe that any of the pollutants listed are present in its discharge. The Division may waive the reporting requirements for individual point sources if the applicant has demonstrated that such a waiver is appropriate because information adequate to support issuance of a permit can be obtained with less stringent requirements. Each applicant must report quantitative data for each outfall containing process wastewater with the following exceptions:

a.) For every pollutant discharged which is not so limited in an effluent limitations guideline, the applicant must either report quantitative data or briefly describe the reasons the pollutant is expected to be discharged.

b.) For every pollutant expected to be discharged in concentrations of 10 µg/l or greater the applicant must report quantitative data. For acrolein, acrylonitrile, 2,4 dinitrophenol, and 2-methyl-4,6 dinitrophenol, where any of these four pollutants are expected to be discharged in concentrations of 100 µg/l or greater the applicant must report qualitative data. For every pollutant expected to be discharged in concentrations less than 10 µg/l, or in the case of acrolein, acrylonitrile, 2,4 dinitrophenol, and 2-methyl-4,6 dinitrophenol, in concentrations less than 100 µg/l, the applicant must either submit quantitative data or briefly describe the reasons the pollutant is expected to be discharged.

c.) The applicant need not provide quantitative data if the pollutant is present in the discharge solely as the result of its presence in intake water. However, the applicant must report such pollutant as present.

Additional WET Testing: All applicants must identify any biological toxicity tests which have been performed within the last 3 years on any of the discharges or the receiving water in relation to a surface discharge from this facility. If this information is contained in DMRs, this step may be omitted. If there are additional tests that were not included in DMRs, then these tests must be submitted.

Activity duration: When did the activity commence? 2013 What is the estimated life of the activity from which the discharge(s) identified in item 13 originate? 50+ years.

Stormwater Discharges: Please review Appendix C. Does the facility fall under any of the industries listed?

☐ NO ☒ YES

If the answer is "yes", please complete the appropriate application for coverage under the applicable stormwater general permit. Applications are available at coloradowaterpermits.com, or by contacting the Stormwater Program at 303-692-3517.

Pollution Prevention Plans: Please describe any pollution prevention or best management plans currently in place which could result in the improvement of water quality. These could include solvent recycling programs, material containment procedures, education, etc.

See Attachment 11

Please include any other information which you feel the Division should be aware of in drafting this permit.

Other Environmental Permits: Does this facility currently have any environmental permits or is it subject to regulation, under any of the following programs? Mark which of the other permits/programs the facility has obtained or is in the process of obtaining or is subject to regulation under.

Under item other mark "yes" if the facility has any of the following permits:

a.) Prevention of Significant Deterioration (PSD) program under the Clean Air Act;
b.) Non-attainment Program under the Clean Air Act; or
c.) National Emission Standards for Hazardous Pollutants (NESHAPS) under the Clean Air Act.
d.) CERCLA

Permit name	Yes	No	Date applied for	Permit no.
Colorado Division of Minerals and Geology Permit	☐	☒		
Underground Injection Control	☐	☒		
Dredge or Fill permit, Section 404 – Army Corps of Engineers	☐	☒		
Resource Conservation and Recovery Act (RCRA)	☐	☒		
CDPS Stormater	☒	☐	TBD	
Colorado State Air Pollution Program	☐	☒		
Other Dam safety permit and solid waste permit	☒		TBD	

REQUIRED SIGNATURES:

Signature of Applicant: The applicant must be either the owner and/or operator of the site. Refer to Part B of the instructions for additional information. The application must be signed by the applicant to be considered complete. In all cases, it shall be signed as follows:

a) In the case of corporations, by a principal executive officer of at least the level of vice-president or his or her duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge described in the application originates.
b) In the case of a partnership, by a general partner.
c) In the case of a sole proprietorship, by the proprietor.
d) In the case of a municipal, state, or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee if such representative is responsible for the overall operation of the facility from which the discharge described in the form originates.

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment.

Signature of **Owner** (submission must include original signature) Date Signed

Name (printed) Title

Signature of **Applicant** (submission must include original signature) Date Signed

Name (printed) Title

Signature of **Operator** (submission must include original signature) Date Signed

Name (printed) Title

Appendix A - Priority Pollutants

Organic Toxic Pollutants in Each of Three Fractions in Analysis by Gas Chromatography/Mass Spectroscopy(GC/MS).

Volatiles
Acrolein
Acrylonitrile
Benzene
Bromoform
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
2-Chloroethylvinyl Ether
Chloroform
Dichlorobromomethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
1,2-Dichloropropane
1,3-Dichloropropylene
Ethylbenzene
Methyl Bromide
Methyl Chloride
Methylene Chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,2-Trans-dichloroethylene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl Chloride

Base/Neutral
Acenaphthene
Acenaphthylene
Anthracene
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
3,4-Benzofluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl) ether
Bis(2-chloroisopropyl) ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butylbenzyl phthalate
2-Chloronaphthalene
4-Chlorophenyl phenyl ether
Chrysene
Dibenzo (a,h) anthracene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3-Dichlorobenzidine
Diethyl phthalate
Dimethyl phthalate
Di-n-butyl phthalate
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octyl phthalate
1,2-Diphenylhydrazine (as azobenzene)
Fluorene
Fluoranthene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorcyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd) pyrene
Isophorone
Naphthalene
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine
Phenanthrene
Pyrene
1,2,4-Trichlorobenzene)

Acid
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
4,6-Dinitro-o-cresol
2,4-Dinitrophenol
2-Nitrophenol
4-Nitrophenol
P-chloro-m-cresol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

Pesticides

Aldrin	Endosulfan Sulfate
Alpha-BHC	Endrin
Beta-BHC	Endrin Aldehyde
Gamma-BHC	Heptachlor
Delta-BHC	Heptachlor Epoxide
Chlordane	PCB-1242
4,4'-DDT	PCB-1254
4,4'-DDE	PCB-1221
4,4'-DDD	PCB-1232
Dieldrin	PCB-1248
Alpha-Endosulfan	PCB-1260
Beta-Endosulfan	PCB-1016
	Toxaphene

Metals, Cyanide, and Total Phenols

Total Recoverable Antimony
Total Recoverable Beryllium
Total Recoverable Thallium
Bromide
Color
Sulfite
Surfactants
Total Magnesium
Total Molybdenum
Total Tin
Total Titanium

Appendix B - Toxic Pollutants and Hazardous Substances

Toxic Pollutants

Asbestos

Hazardous Substances

Acetaldehyde
Allyl alcohol
Allyl chloride
Amyl acetate
Aniline
Benzonitrile
Benzyl chloride
Butyl acetate
Butylamine
Captan
Carbaryl
Carbofuran
Carbon disulfide
Chlorphyrifos
Coumaphos
Cresol
Crotonaldehyde
Cyclohexane
2,4-D (2,4-Dichlorophenoxy acetic acid)
Diazinon
Dicamba
Dichlobenil
Dichlone
2,2-Dichloropropionic acid
Dichlorvos
Diethyl amine
Dimethly amine
Dinitrobenzene
Diquat
Disulfoton
Diuron
Epichlorohydrin
Ethion
Ethylene diamine
Ethylene dibromide
Formaldehyde
Furfural
Guthion
Isoprene
Isopropanolamine dodecylbenzenesulfonate
Kelthane
Kepone
Malathion
Mercaptodimethur
Methoxychlor
Methyl mercaptan
Methyl methacrylate
Methyl parathion
Mevinphos
Mexacarbate
Monoethyl amine
Monomethyl amine
Naled
Naphthenic acid
Nitrotoluene
Parathion
Phenolsulfanate
Phosgene
Propargite
Propylene oxide
Pyrethrins
Quinoline
Resorcinol
Strontium
Strychnine
Styrene
2,4,5-T (2,4,5-Trichlorophenoxy acetic acid)
TDE (Tetrachlorodiphenyl ethane)
2,4,5-TP [2-(2,4,5-Trichlorophenoxy) propanoic acid]
Trichlorofan
Triethanolamine dodecylbenzenesulfonate
Triethylamine
Trimethylamine
Uranium
Vanadium
Vinyl acetate
Xylene
Xylenol
Zirconium

APPENDIX C - INDUSTRIES REQUIRED TO OBTAIN STORMWATER DISCHARGE PERMITS

The **Standard Industrial Classification (SIC) Code** or codes for the facility usually determines permit coverage. SIC Codes are assigned according to the primary activities performed by a company. They are often assigned for insurance purposes or when a business registers as a corporation. Industries can also determine their SIC Code by checking with their trade association, Chamber of Commerce, legal counsel, or library for the SIC Manual, or online at www.osha.gov/pls/imis/sic_manual.html.

The industries are listed here by their SIC Code. The manufacturing industries are generally represented by SIC Codes 20-39. (A two digit code, such as 42, means that **all** industries under that heading, from 4200 to 4299, are covered.) Use this table to determine which of the Division's general permits is appropriate for your facility.

SIC Code	Industry Type	Notes	Permit Type
10	Metal mining and milling, metal mining services	(a)	M
12	Coal mining, coal mining services	(a)	C, M
13	Oil and gas extraction, oil and gas services	(b)	A
14	Mining and quarrying of nonmetallic minerals except fuels (e.g., sand and gravel)	(a)	S
NA	Construction	(f)	N
20	Food and kindred products (except)	(g)	A
2011	Meat packing plants	(g)	B
2015	Poultry slaughtering and processing	(g)	B
2077	Animal and marine fats and oils	(g)	B
21	Tobacco products	(g)	A
22	Textile mills	(f) (g)	A
23	Apparel and other finished products made from fabric and similar material	(g)	A
24	Lumber and wood products except furniture (except)	(g)	A
2491	Wood preserving	(f) (g)	B
25	Furniture and fixtures	(g)	A
26	Paper and allied products	(g)	A
27	Printing, publishing, and allied products	(g)	A
28	Chemicals and allied products (except)	(f) (g)	B
283	Drugs	(f)(g)	B
285	Paints and allied products	(g)	B
29	Petroleum refining and related industries (except)	(f)	B
2951	Asphalt batch plants	(c)	A,N,S
30	Rubber and miscellaneous plastics products	(f) (g)	B
31	Leather Products (except)	(g)	A
311	Leather tanning and finishing	(f)	A
32	Stone, clay, glass and concrete products (except)	(g)	A
3241	Cement manufacturing	(f)	B
3273	Ready-mix concrete facilities	(c)	A,N,S
33	Primary metals industries	(f) (g)	B
34	Fabrication of metal products, except machinery and transportation equipment (except)	(g)	A
3441	Fabricated structural metal	(g)	A
35	Industrial and commercial machinery and computer equipment	(g)	A
36	Electronic and other electrical equipment and components, except computer equipment	(g)	A
37	Transportation equipment	(g)	A

APPENDIX C

SIC Code	Industry Type	Permit Notes	Type
38	Measuring, analyzing, and controlling instruments: photographic, medical, and optical goods, watches and clocks	(g)	A
39	Miscellaneous manufacturing industries	(g)	A
40	Railroad transportation	(d) (g)	A
41	Local and suburban transit and interurban highway passenger transportation	(d) (g)	A
42	Motor freight transportation and warehousing (except)	(d) (g)	A
4221	Farm Product warehousing and storage	(g)	A
4222	Refrigerated warehousing and storage	(g)	A
4225	General warehousing and storage	(g)	A
44	Water Transportation	(d) (g)	A
45	Transportation by Air	(d) (e) (g)	A,B
4911	Steam electric power generation (all fuel types)	(f) (g)	B
4952	Wastewater treatment plants with a design flow of 1.0 MGD or more, or required to have an approved pretreatment program under 40 CFR 403	(f) (g)	A
4953	Hazardous waste treatment, storage or disposal facilities; incinerators (including boilers and industrial furnaces) that burn hazardous waste; and active or inactive landfills, land application sites, or open dumps w/industrial waste and w/o stabilized final cover	(f) (g)	B
5015	Motor vehicle parts, used		R
5093	Scrap and waste materials		R
5171	Petroleum bulk stations and terminals	(d) (g)	A

Notes:

(a) For this SIC Code, a stormwater permit is required only if runoff contacts overburden, raw material, intermediate or finished product, or waste products.

(b) For this SIC Code (oil and gas facilities), a stormwater permit is essentially required only the facility has had a discharge of a reportable quantity. See Colorado Discharge Permit System Regulations, Section 61.4(3)(b)(i)(C).

(c) Facilities at sand and gravel operations may be covered under permit S; facilities at construction sites may be covered under permit N; other facilities, including mobile plants, may be covered under permit A.

(d) For this SIC Code, only facilities with vehicle maintenance (including fueling), equipment cleaning, or airport deicing need a stormwater permit.

(e) Airports that use 1000 gallons of deicer(s) or more annually (undiluted), and that have annual fuel sales of one million gal/year or more, are covered under permit B. Airports that do not meet these criteria need permit A.

(f) For most facilities covered by the stormwater regulations, SIC codes are used to indicate the **primary** function of the facility. This footnote denotes industries which, in most cases, are covered under the stormwater regulations regardless of what other activities are conducted at the site (contact Division for details).

(g) For this SIC Code, if **all** industrial activity, materials handling and storage at the facility are protected from precipitation, the facility may qualify for coverage under the No Exposure Exclusion. If that case, stormwater permit coverage would not be required. See http://www.cdphe.state.co.us/wq/PermitsUnit/stormwater/NoExposure.PDF

Permit types:
- A: **Light Industry** General Permit (Permit No. COR-010000)
- B: **Heavy Industry** General Permit (Permit No. COR-020000)
- N: **Construction** General Permit (Permit No. COR-030000) (see Instructions, Item C.4)
- M: **Metal Mining** General Permit (Permit No. COR-040000)
- C: **Coal Mining** General Permit (Permit No. COG-850000)
- S: **Sand and Gravel** General Permit (Permit No. COG-500000)
- R: **Recycling Industry** General Permit (Permit No. COR-600000)

Appendix D -- GENERAL REQUIREMENTS FOR DISCHARGES TO GROUND WATER FROM

IMPOUNDMENTS, LAND APPLICATION AND SEPTIC SYSTEMS >2000 GPD

(1) FACILITY MAPPING: See Site map information in this application.

(2) FACILITY SKETCH: See Sketch information in this application.

(3) SITE STUDIES/INFORMATION: Provide a copy of any studies, geological reports, consultant reports, water quality analyses pertinent to your facility/site which you feel may help the Division in the development your ground-water permit. Include such reports/studies that address such areas of interest as ground-water quality analyses that establish ambient (existing ground-water quality prior to your ownership of the property), all Material Safety Data Sheets (MSDS) for each chemical used at your facility (an example MSDS is available from the Ground Water Unit), well driller's logs and pumping information of the local aquifer, any computer modelling results that have been performed for the immediate area, U. S. Geological Survey (USGS) reports for the area, etc.

(4) GEOLOGY/HYDROGEOLOGY OF SITE: (a) Describe the local geology of the site. Identify and describe all lithologic units from the ground surface to the first impermeable stratigraphic unit. Provide the estimated thickness of each unit. Include a geologic map or cross sections, if necessary. Maps will be on 8.5 X 11 paper.

(b) Describe the hydrogeology of the site. Describe in detail the relationship of this site to any alluvial or bedrock water bearing formations (unconfined, confined, or perched) and surface water (lakes, ponds, ditches or streams). Identify aquifer name or formation name for each water bearing formation and provide the depth to water (include water elevation) for each. Describe any unusual geologic or hydrologic features that could affect ground water rate of movement or direction of movement (i.e. faults, fractures).

(c) Describe aquifer characteristics (transmissivity or permeability, porosity and storage capacity) of these water bearing formations. State the source(s) of this information.

(d) Provide potentiometric surface (ground water level) map(s) of the water bearing formations. Document information source(s), if obtained from published data. If water levels are contoured from site data, control points must be annotated with water table elevation and time period of measurements indicated in legend. Map must be legible and no larger than 11 X 17 inches paper.

(e) Discuss any hydrogeologic investigations or ground-water modeling conducted at this site.

(5) Water Quality Sampling Requirements The Discharge Regulations have specific requirements [61.4. (7)] for effluent characterization. These requirements are listed below. In addition, the Division is requiring a ground water quality characterization, which is found in paragraph (a), below.

(a) Each applicant must submit (i) a description of the ground water in the sample prior to filtration [i.e. clear, murky, cloudy, etc.] (ii) the below listed analytical data used to document (A) ambient ground water near the impoundment, land application and/or leach field, and (B) the upgradient ground-water quality; (iii) indicate the sample location (well # and depth) and, how sample was obtained; (iv) have the analytical laboratory indicate the method used and the detection limits of the method:

Total Coliforms
Biochemical Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)
Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Total Ammonia as N
Temperature
pH
Nitrate as N

(CONTINUED ON NEXT PAGE)

CHARACTERIZATION OF GROUND WATER
(Measured as dissolved concentration)

Sodium (Na)	Chloride (Cl)
Calcium (Ca)	Bicarbonate (HCO_3)
Magnesium (Mg)	Sulfate (SO_4)
Potassium (K)	Carbonate (CO_3)
Iron (Fe)	Total Dissolved Solids

(b) Each applicant must sample, analyze and report to the Division any of the below listed pollutants he/she knows or has reason to believe may be present in the ground water below his/her property;

(i) TABLE III OF APPENDIX D, PART 122,TITLE 40 OF THE CODE OF FEDERAL REGULATIONS; OTHER TOXIC POLLUTANTS (METALS AND CYANIDE) AND TOTAL PHENOLS (UNLESS INDICATED OTHERWISE, ANLYZE THE FOLLOWING FOR THE DISSOLVED CONCENTRATION):

ANTIMONY	ARSENIC
BERYLLIUM	CADMIUM
CHROMIUM**	COPPER
LEAD	MERCURY
NICKEL	SELENIUM
SILVER	THALLIUM
ZINC	CYANIDE, WEAK ACID DISSOCIABLE
TOTAL PHENOLS	

** = If the dissolved concentration for chromium exceeds 0.1 mg/l, then an additional analysis for hexavalent chromium shall be performed

(ii) TABLE II OF APPENDIX D, PART 122, TITLE 40 OF THE CODE OF FEDERAL REGULATIONS; ORGANIC TOXIC POLLUTANTS IN EACH OF THE FOUR FRACTIONS IN ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (GC/MS)--CONSIDER ALL POLLUTANTS LISTED FOR EACH FRACTION INDICATED FOR YOUR INDUSTRY, AS INDICATED IN THE CHART ON PAGE 4 OF THIS APPLICATION:

The list of organic toxic pollutants in each of four fractions -"Volatiles, Base/Neutral, Acid and Pesticides" - is found in "Appendix A - Priority Pollutants". Measure the dissolved concentration for each of the parameters listed that you know or believe will be present at your facility.

(iii) TABLE V OF APPENDIX D, PART 122, TITLE 40 OF THE CODE OF FEDERAL REGULATIONS; TOXIC POLLUTANTS AND HAZARDOUS SUBSTANCES.

The list of toxic pollutants and hazardous substances is found in "Appendix B", above. Measure the dissolved concentration for each of the parameters listed that you know or believe will be present at your facility.

(c) Each applicant is required to report that 2,3,7,8 Tetrachlorobenzo-P-Dioxin (TCDD) may be in the ground water based upon whether he/she uses or manufactures one of the below listed compounds or whether he/she knows or has reason to believe that TCDD will or may be present in the soil or ground water.

(i) 2,4,5-trichlorophenoxy acetic acid (2,4,5-T) (CAS #93-76-5);
(ii) 2-(2,4,5-trichlorophenoxy) propanoic acid (Silvex, 2,4,5-TP) (CAS #93-72-1);
(iii) 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (Erbon) (CAS #136-25-4);
(iv) 0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothioate (Ronnel) (CAS #299-84-3);
(v) 2,4,5-trichlorophenol (TCP) (CAS #95-95-4); or
(vi) Hexachlorophene (HCP) (CAS #70-30-4).

APPENDIX E-1- IMPOUNDMENTS

SPECIFIC REQUIREMENTS FOR IMPOUNDMENTS

COMPLETE THIS PORTION OF THE APPLICATION FOR EACH IMPOUNDMENT AT YOUR FACILITY

1) CHECK ANY OF THE FOLLOWING THAT PERTAIN TO THIS FACILITY:

- ☐ _____(a)The impoundment(s) at this facility is(are) subject to regulation under the Uranium Mill Tailings Radiation Control Act.
- ☐ _____(b) The impoundment(s) at this facility is(are) used in the treatment, storage or recharge of raw or potable water.
- ☐ _____(c)The impoundment(s) at this facility is(are) used only for storm water retention or detention. Provide a copy of the Stormwater permit with this application, if applicable.
- ☐ _____(d) The impoundment currently has a valid certificate of designation [C.D.] (pursuant to the Solid Waste Disposal and Facilities Act, CRS 1973 30-20-101 et seq. as amended). Provide a copy of the C.D. with this application.
- ☐ _____(e) This facility has an Underground Injection Control Permit or Authorization by Rule (Safe Drinking Water Act, 42 USC 300f, et seq.). Provide a copy of the permit or authorization by rule.
- ☐ _____(f) This facility has an impoundment which is subject to the jurisdiction of one of the following State agencies:
  - _____(i) Minerals and Geology Division (formerly Mined Land Reclamation)
  - _(ii) State Engineer's Office
  - _____(iii) Oil and Gas Conservation Commission
  - _____(iv) Hazardous Materials and Waste Management Division

  If you checked any of the above State agencies, please provide, on a separate sheet of paper, the contact person's name and telephone number and all pertinent identification for your facility, as provided to you by the State agency.
- ☐ _____ (g) This facility is subject to regulation under the "Confined Animal Feeding Operation Control Regulation", 4.8.0.

IF THE ONLY IMPOUNDMENT(S) AT THIS SITE IS (ARE) ONE (OR MORE) OF THE ABOVE AND LAND APPLICATION AND/OR SEPTIC SYSTEM ARE/IS NOT APPLICABLE, REFER TO "31" IN THIS APPLICATION.

2) Provide detailed plan and side view sketches of impoundment, include liner thickness (if lined) and depth to ground water.

3) Provide technical information on liner type, materials used in construction, thickness and installation.

4) Provide results of "in situ" permeability testing of the clay liner or the expected permeability of a synthetic liner for the bottom and sides of the impoundment.

APPENDIX E-2 - LAND APPLICATION

SPECIFIC REQUIREMENTS FOR LAND APPLICATION

COMPLETE THIS PORTION OF THE APPLICATION ON SEPARATE SHEETS OF PAPER AND ATTACH THEM TO THE APPLICATION AS APPENDIX E-2

(1) Analytical data used to document ambient ground-water quality should be submitted for the following parameters (Unless otherwise indicated, determine the dissolved concentration of each of the following):

Aluminum	Beryllium	Arsenic	Silver
Boron	Cobalt	Barium	Cadmium
Copper	Lithium	Chromium	Cyanide (Weak Acid Dissociable)
Nickel	Vanadium	Fluoride	Lead
		Mercury	Zinc
		Nitrite	Selenium
		Manganese	Color
		Copper	Corrosivity
		Foaming Agents	Odor
		Gross Alpha (excl. Radon/Uranium)	
		Beta and Photon Emitters	

(2) Provide a description of the A and B soil horizons mapped at this site by the U. S. Soil Conservation Service.

(3) Describe the existing vegetative cover at the site. Include plans for any proposed disturbance or planting.

(4) Does this land application plan use the root zone for attenuation of effluent components? If so, explain in detail. Include a report of the vadose zone modelling, if performed.

(5) Provide all information pertaining to precipitation, evapotranspiration, and infiltration for this site (supplemental irrigation, solar and wind evaporation, plant uptake, infiltration tests).

(6) Describe the proposed rate and schedule of application and its expected effects on ground water levels.

(7) The following parameters should be determined from soil samples taken at one foot intervals to a depth of five feet. It is preferred that these soil samples be collected in the spring. These results are to be provided to the Division, when they are available (Parameters are to be measured as Total concentrations (using the AB-DPTA extraction--Contact Jim Self at the CSU Soil Laboratory), as appropriate).

aluminum	copper	nitrate residuals	zinc
iron	nickel	ammonia residuals	
arsenic	lead	phosphorous	
cadmium	mercury	potassium	
chromium	molybdenum	selenium	

(8) Describe the effluent storage capacity during inclement weather and/or frozen ground.

APPENDIX E-3 - SEPTIC SYSTEMS GREATER THAN 2000 GALLONS PER DAY (GPD)

SPECIFIC REQUIREMENTS FOR SEPTIC SYSTEM >2000 GPD

FACILITY WASTESTREAM

DOMESTIC WASTE □ Yes □ No

INDUSTRIAL WASTE □ Yes □ No

Indicate "Facility Type" and indicate, below, the Design Capacity of the septic system plus whether the facility also has Impoundment(s) or Land Application associated with it.

Suggested "Facility Type"

Industrial/Domestic Wastewater: (a) Business; (b) Ski Area; (c) Campground/R.V. Park; (d) Motel/Hotel/Dude Ranch; (e) Community System; (f) School; (g) Church; (h) Hardrock Mining/Milling / Placer Mining / Coal Mining; (i) Sand and Gravel Production; (j) Construction Dewatering; (k) Ground Water Cleanup of Gasoline/Diesel

FACILITY TYPE ______________________________

SEPTIC SYSTEM DESIGN CAPACITY = ____________________gpd

Circle the appropriate components of the septic system:

TWO STAGE SYSTEM:

FIRST STAGE	*(a) SEPTIC TANK* *(b) AERATION SYSTEM*		
SECOND STAGE	*(a) BED*	*(1) PIPE & GRAVEL* *(2) GRAVELLESS CHAMBERS*	
	(b) TRENCH	*(3) GRAVELLESS PIPE*	

THREE STAGE SYSTEM:

FIRST STAGE	*(a) SEPTIC TANK* *(b) AERATION SYSTEM*		
SECOND STAGE	*SAND FILTER*		
THIRD STAGE	*(a) BED*	*(1) PIPE & GRAVEL* *(2) GRAVELLESS CHAMBERS*	
	(b) TRENCH	*(3) GRAVELLESS PIPE*	

| *IMPOUNDMENT* *No* *Yes* *# of Impoundments*______
LENGTH and WIDTH of each pond at water surface L_1________*ft* W_1 ________*ft*

DEPTH of each pond D_1 _______*ft; HORIZONTAL SLOPE of sides of pond* ____:____
(Attach extra sheets of paper as required.)

| *LAND APPLICATION* *No* *Yes* *Type*______________________

If the response is "Yes" to either the impoundment or land application question, please refer to *E-1 OR E-2, RESPECTIVELY.*

APPENDIX F

ENVIRONMENTAL PERMIT INFORMATION

TYPES OF PERMITS AVAILABLE FOR FACILITIES:

1. USEPA UNDERGROUND INJECTION CONTROL PERMIT;

2. COLORADO DEPARTMENT OF HEALTH STORMWATER PERMIT;

3. COLORADO DEPARTMENT OF HEALTH AIR POLLUTION EMISSION PERMIT;

4. COLORADO DIVISION OF MINERALS AND GEOLOGY PERMIT;
   (Please include the mined land reclamation board permit anniversary date.)

5. RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
   I. RCRA SUBTITLE C HAZARDOUS WASTE:
      i) PROVIDE YOUR RCRA EPA ID NUMBER;
      ii) PROVIDE YOUR STATE RCRA PERMIT NUMBER;
      iii) DO YOU NOW HAVE OR HAVE YOU IN THE PAST HAD INTERIM STATUS?

   II. RCRA SUBTITLE D SOLID WASTE:
      i) HAS A CERTIFICATE OF DESIGNATION (CD) FOR SOLID WASTE DISPOSAL BEEN ISSUED FOR THIS SITE?
      ii) ARE YOU DISPOSING OF YOUR OWN WASTE ON YOUR OWN PROPERTY?
      iii) DO YOU HAVE AN APPLICATION FOR A CD PENDING?
      iv) IF THIS FACILITY IS A MINING OPERATION, ARE YOU DISPOSING OF MINE WASTE ON YOUR OWN PROPERTY?
      v) HAVE YOU DONE ANY RECYCLING AT THIS SITE?
      vi) IS THERE BENEFICIAL USE OR DISPOSAL OF BIOSOLIDS OR SEPTAGE AT THIS PROPERTY?
      vii) IS YOUR PROPERTY USED AS A TRANSFER STATION?

   III. RCRA SUBTITLE I UNDERGROUND STORAGE TANKS
      i) ARE THERE EITHER ABOVE GROUND OR BELOW GROUND TANKS ON THIS PROPERTY?
      ii) HAS THERE BEEN A RELEASE FROM THE TANK SYSTEM?--IF YES, THEN RESPOND TO "iii)".
      iii) HAS ASSESSMENT WORK BEEN PERFORMED?--IF YES, THEN RESPOND TO "iv)".
      iv) HAS A CORRECTIVE ACTION PLAN BEEN APPROVED OR PERFORMED?

6. URANIUM MILLS TAILINGS REMEDIAL ACTION PROGRAM (UMTRAP):
   IS THERE A REMEDIAL ACTION PLAN PENDING OR IN PLACE AT THIS PROPERTY?
      i) IS THERE A SURFACE DISCHARGE PERMIT?
      ii) IS THERE AN AIR EMISSSIONS PERMIT?

7. COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA):

   IS THIS PROPERTY LISTED AS A SUPER FUND SITE?

APPENDIX G
LOCAL RESOURCES OF INFORMATION

U.S. Geological Survey Library — Telephone: 303/236-1000
Building 20
Denver Federal Center *

U.S. Geological Survey Map Sales — Telephone: 303/236-7476
Building 810
Denver Federal Center *

* Located in Lakewood between Sixth Avenue and Alameda Boulevard, Kipling Street and Union Boulevard

Office of the Colorado State Engineer — Telephone: 303/866-3581
1313 Sherman Street
Room 818
Denver, Colorado

Soil Survey Maps are located at:
Soil Conservation Service — Telephone: 303/236-2897
655 Parfet Street
Room E 200 C
Lakewood, Colorado 80215-5517

US EPA Region VIII — Telephone: 303/293-1430
Mr. Chet Pauls
Underground Injection Control Program
999 18th St.
Suite 500
Denver, Colorado 80202-2466

Air Pollution Control Division — Telephone: 303/692-3100
Hazardous Materials and Waste Management Division — Telephone: 303/692-3300
Radiation Control Division — Telephone: 303/692-3030
Colorado Department of Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530

Laboratory Division at the — Telephone: 303/691-4700
Colorado Department of Health and Environment
4210 East 11th Avenue
Denver, Colorado 80220

APPLICATION GENERAL INFORMATION AND INSTRUCTIONS

This application is for use by all industrial **process water dischargers to surface water, ground water or stormwater dischargers**. Discharges to ground water may occur from impoundments that are either non-discharging to surface water or discharging to surface water, land application and septic systems, whose design capacity is greater than 2000 gallons per day. The Division has industry specific permits for construction dewatering, gasoline clean up sites, water treatment plants, hardrock mining, coal mining, non-metallic metals mining and placer mining along with several for stormwater only discharges. If the facility falls under one of these activities, please contact the Division for the appropriate application. This form may be reproduced. For information on electronic copies, please contact the Permits and Enforcement Section at 692-3590.

WATER RIGHTS

The State Engineers Office (SEO) has indicated that any discharge that does not return water directly to surface waters (i.e. land application, rapid infiltration basins, etc.) has the potential for material injury to a water right. As a result, the SEO needs to determine that material injury to a water right will not occur from such activities. To make this judgement, the SEO requests that a copy of all documentation demonstrating that the requirements of Colorado water law have been met, be submitted to their office for review. The submittal should be made as soon as possible to the following address:

Colorado Division of Water Resources
1313 Sherman St. Rm 818
Denver, Colorado 80203

Should there be any questions on the issue of water rights, the SEO can be contacted at (303) 866-3581. It is important to understand that any CDPS permit issued by the Division **does not constitute a water right. Issuance of a CDPS permit does not negate the need to also have the necessary water rights in place.** It is also important to understand that even if the activity has an existing CDPS permit, this is no guarantee that the proper water rights are in place.

Atlantic Richfield Company, Rico Mine

Colorado Discharge Permit System Application

Attachments

Required by Application Form:

Attachment 1	Regional Map
Attachment 2	Location Map
Attachment 3	Site maps
Attachment 4	Water Balance
Attachment 5	MSDS for hydrated lime
Attachment 6	Description of lime treatment system and proposed schedule for construction and operation
Attachment 7	Average flows and treatment
Attachment 8	Discharge quality of effluent
Attachment 9	Dioxin testing
Attachment 10	WET testing and Priority Pollutant Scan
Attachment 11	Pollution Prevention Plans
Attachment 12	Pond (impoundment) descriptions
Attachment 13	Geology/hydrology summary

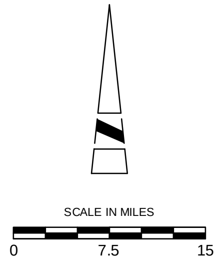
Additional Attachments:

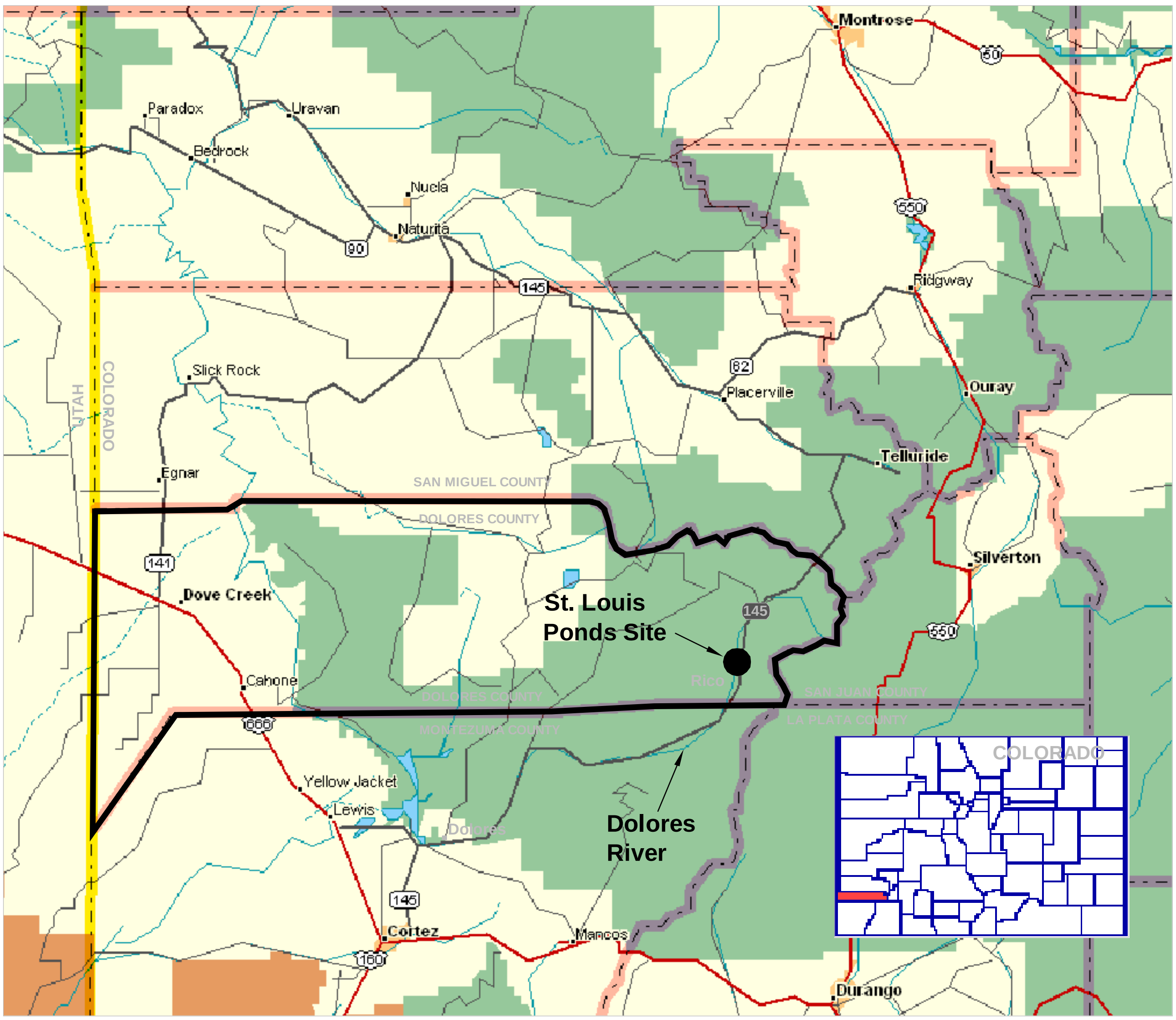
Attachment 14	Summary of site history and operation
Attachment 15	2008 Water Quality Assessment
Attachment 16	Mixing Zone Analysis
Attachment 17	Current and anticipated land access/ownership status

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 1

Regional Map





AECOM

AECOM Technical Services, Inc.
717 17th ST., SUITE 2600
DENVER, COLORADO 80202
T 303.228.3000 F 303.228.3001
www.aecom.com

ST. LOUIS PONDS
CDPS PERMIT APPLICATION

REGIONAL MAP

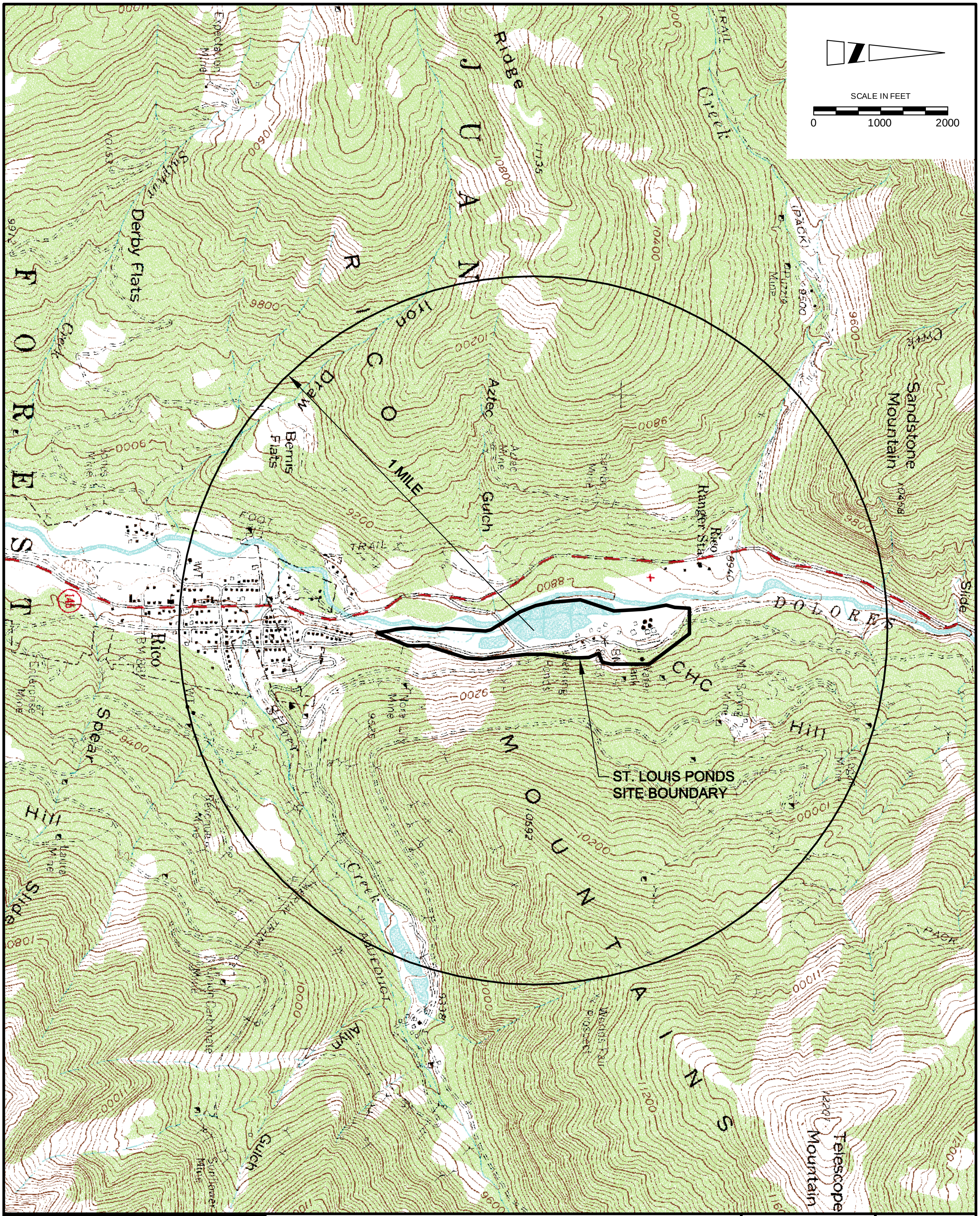
AECOM PROJECT NO.
60157757

FIGURE
1-1

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 2

Location Map



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www.aecom.com

ST. LOUIS PONDS
CDPS PERMIT APPLICATION

LOCATION MAP

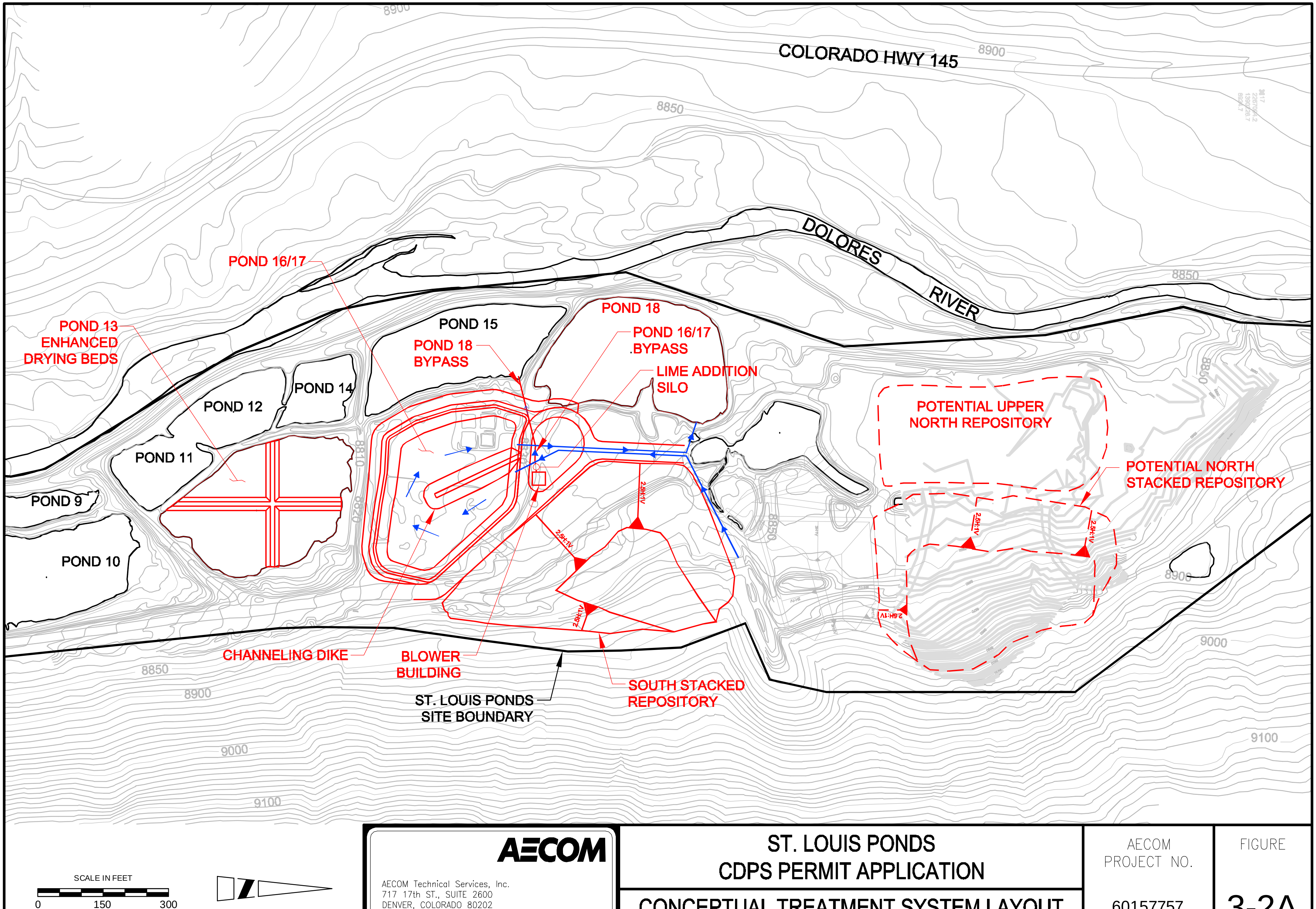
AECOM PROJECT NO.	FIGURE
60157757	2-1

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 3

Site maps

AECOM	ST. LOUIS PONDS CDPS PERMIT APPLICATION	AECOM PROJECT NO.	FIGURE
AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	EXISTING SITE FEATURES MAP	60157757	3-1



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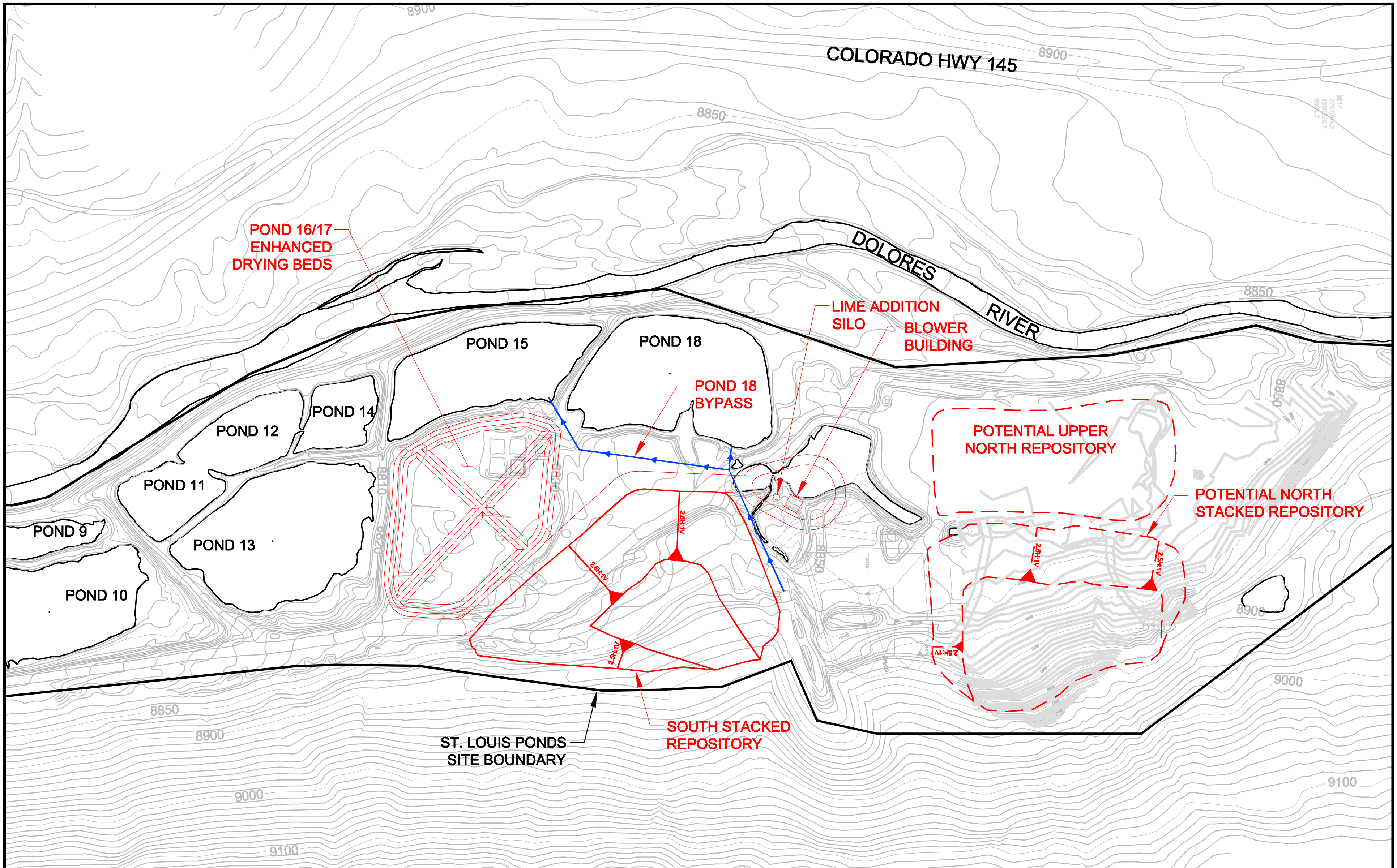
ST. LOUIS PONDS
CDPS PERMIT APPLICATION

CONCEPTUAL TREATMENT SYSTEM LAYOUT
DESIGN ALTERNATIVE 1

AECOM PROJECT NO. 60157757

FIGURE 3-2A



SCALE IN FEET

0 150 300

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ST. LOUIS PONDS
CDPS PERMIT APPLICATION

CONCEPTUAL TREATMENT SYSTEM LAYOUT
DESIGN ALTERNATIVE 2

AECOM PROJECT NO.
60157757

FIGURE
3-2B

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 4

Water Balance

Water Balance

Figure 4-1 is a water balance based on existing conditions at the St. Louis Ponds. In the water balance, the Ponds System is treated as a whole, with the two key flows being the influent and effluent from the entire system. Internally, losses include seepage and evaporation with gains being from precipitation and local geothermal wells.

Average annual precipitation at Rico is estimated at 26.25 in/yr (1948-2001). Annual free-surface evaporation for the Rico area is estimated at 35 in/yr. The flow rates illustrated on Figure 4-1 are based on precipitation directly on the ponds and/or evaporation directly from the ponds. Both precipitation and evaporation rates vary throughout the year with the highest rate of precipitation in the winter in the form of snow, and the highest rate of evaporation in the late summer and fall. On an annual basis the two factors tend to approximately balance each other out. An existing pond water surface area of 10.5 acres was used in the calculations.

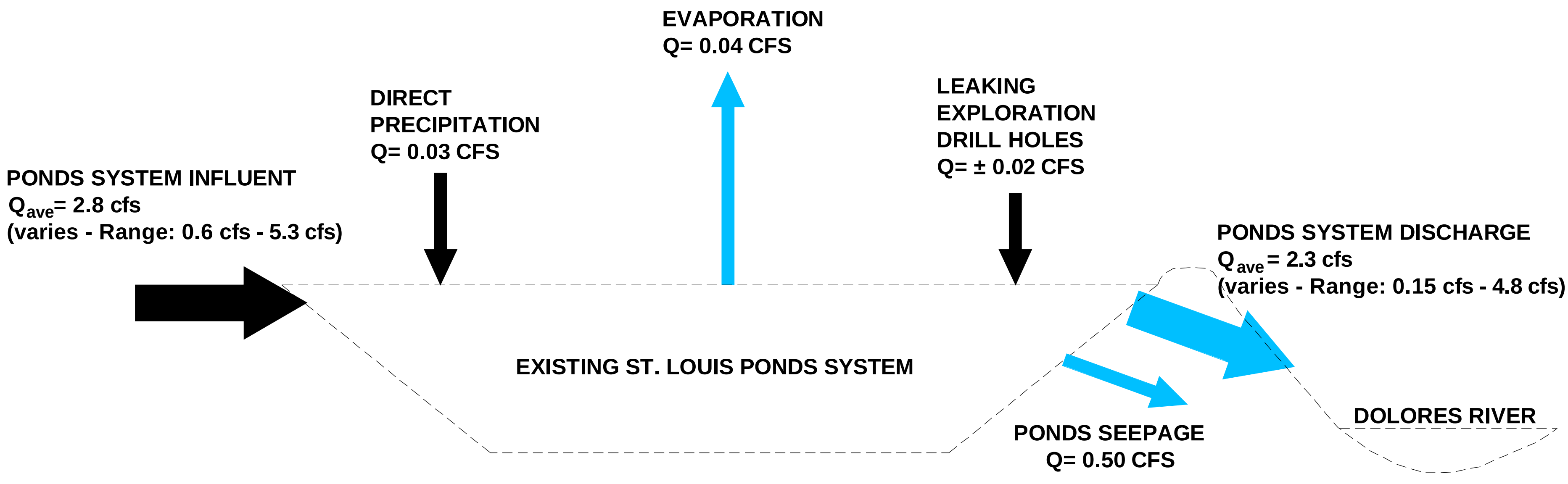
Runon to the ponds system is assumed to be minimal. In general, the ponds are isolated from runon by high infiltration rates in the colluvium/talus covered slopes above the site and roadways or embankments above the surrounding ground, largely minimizing runon. During field inspections no indication of flow into the ponds from the hills above the ponds has been noted (i.e., there are no erosion channels or culverts across the access roadway). As part of the proposed design, additional storm water routing would be implemented as necessary to further reduce runon potential. It is estimated to be less than 0.02 cfs on average for purposes of this water balance.

Several leaking abandoned mineral exploration drill holes discharge natural artesian geothermal groundwater into one or more of the lower ponds via surface flow. It is currently assumed that they will not have a significant effect on the planned water treatment system operations.

Existing ponds seepage was estimated by subtracting measured effluent from the ponds from measured influent to the ponds while considering that internal gains and losses other than seepage are essentially offsetting. Data for the period of October 2002 through January 2006 were evaluated. A total of 40 sets of paired inflow/outflow measurements were used. The period of evaluation was an abnormally dry period, which, for that period, would result in precipitation values less than shown on Figure 4-1 and evaporation rates possibly greater than illustrated. These considerations would suggest that a slightly lower estimate of seepage could be appropriate. The estimated existing seepage rate of 0.5 cfs (range 0.4 – 0.6 cfs) results in an overall seepage rate of 0.048 cfs/acre over the existing 10.5 acre ponds surface area. As discussed in Attachment 13 (Geology/Hydrology Summary) much of the seepage from the Ponds System reemerges as surface water and reaches the Dolores River adjacent to or within close proximity downstream of the Ponds System.

Design alternative 1, if implemented, proposes the addition of the Pond 16/17 primary treatment cell (and wet closure of underlying tailings), which would add to the seepage component. The two combined ponds would add a water surface area of approximately 2.2 acres. Assuming a seepage rate proportional to the remainder of the ponds (0.048 cfs/acre) would add an additional 0.10 cfs seepage. It is expected that the seepage rate would be greater initially and reduce over time as precipitated solids from the inflow fill void space in the upper portion of the soils underlying the settling ponds.

In the existing pond system, the upper ponds (Ponds 18, 15, 14, 12, and 11) are situated with water levels perched above the ambient groundwater and adjacent river level, whereas the water levels in the lower ponds are closer to the level of the surrounding groundwater, suggesting that an above average rate of seepage may derive from the upper ponds (all other factors assumed approximately equal – note that the existing lower ponds do not contain as much precipitated/settled solids as the upper ponds which would in part counter the increased head in the upper ponds). The planned new Pond 16/17 would be positioned above the ambient groundwater level and could thus have a higher initial seepage rate than the average of the existing ponds. Existing ponds were excavated into the alluvial aquifer (sand, gravel and cobles) and hydraulic conductivity through the base of the ponds has decreased over time through natural sedimentation and precipitation of treatment solids during prior periods of lime addition. The new Pond 16/17 would be constructed within a much finer-grained material (the existing calcine tailings) and as such would be expected to seal more quickly and to a lower than average hydraulic conductivity (i.e., permeability). It is anticipated that the end result would be a seepage rate from Pond 16/17 on the order of, and possibly lower than, the existing average seepage rate for the overall Ponds System.



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WATER BALANCE - EXISTING CONDITIONS

AECOM PROJECT NO. 60157757

FIGURE 4-1

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 5

MSDS for hydrated lime

GRAYMONT

MATERIAL SAFETY DATA SHEET

SECTION I - CHEMICAL PRODUCT AND COMPANY INFORMATION

Product Name:	**HIGH CALCIUM HYDRATED LIME**	**WHMIS – CLASSIFICATION:** **D2A / D2B: MATERIALS CAUSING OTHER TOXIC EFFECTS** **E: CORROSIVE MATERIAL**

MANUFACTURER'S AND SUPPLIER'S NAME:

GRAYMONT (NB) INC	4634, Route 880, Havelock, New Brunswick, E4Z 5K8.
GRAYMONT (QC) INC.	25, rue De Lauzon, Boucherville (Québec), J4B 1E7.
GRAYMONT (PA) INC.	965, East College avenue, Pleasant Gap, PA 16823
GRAYMONT (WESTERN CANADA) INC.	190 – 3025, 12 Street N.E., Calgary, Alberta, T2E 7J2
GRAYMONT (WESTERN US) INC.	3950 South, 700 East, Suite 301, Salt Lake City, Utah 84107

EMERGENCY TEL. No.: (613) 996 – 6666 CANUTEC (Canada) (800) 424 – 9300 CHEMTREC (US)

Chemical Name	Chemical Family	Chemical Formula
Calcium hydroxide	**Alkaline earth hydroxide**	**Complex mixture - mostly $Ca(OH)_2$**
Molecular Weight	Trade Name and Synonyms	Material Use
$Ca(OH)_2$ = 74.096	**Hydrated Lime, Lime, Slaked lime, Lime Putty, Lime Slurry, Milk of Lime, Calcium Hydroxide**	**Neutralization, Flocculation, Stabilization, absorption**

SECTION II - COMPOSITION AND INFORMATION ON INGREDIENTS

Hazardous Ingredients	Approximate Concentration (% by weight)	C.A.S. Number	Exposure limits (mg/m^3)					
			OSHA PEL	ACGIH TLV	RSST VEMP	MSHA PEL (Note 2)	NIOSH REL	NIOSH IDLH
(Complex Mixture)	**(% by weight)**		**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 10/40h**	
Calcium hydroxide	**92 to 100**	**1305-62-0**	**15 (tot dust) 5 resp dust**	**5**	**5**	**5**	**5**	**N/A**
Crystalline Silica, Quartz	**0.1 to 1**	**14808-60-7**	**10/(%SiO_2)+2 respirable silica dust**	**0.025 respirable silica dust**	**0.1 respirable silica dust**	**10/(%SiO_2)+2 respirable silica dust**	**0.05 respirable free silica**	**50**
Crystalline Silica, Quartz	**0 to 0.1** (Note 1)	**14808-60-7**	**10/(%SiO2)+2 respirable silica dust**	**0.025 respirable silica dust**	**0.1 respirable silica dust**	**10/(%SiO2)+2 (respirable silica dust)**	**0.05 respirable free silica**	**50**

(**Note 1**): Concentration of crystalline silica in a series of lime products will vary from source to source. It was not detected on some samples (< 0.1% w/w). Therefore two ranges are being disclosed. **(Note 2)**: ACGIH TLV Version 1973 has been adopted by the Mine Safety Health Administration (MSHA) as the regulatory Exposure Standard.

SECTION III - PHYSICAL AND CHEMICAL DATA

Physical State	Odor and Appearance		Odor Threshold (p.p.m.)	Specific Gravity
Gas ☐ Liquid ☐ Solid ☑	**Slight earthy odor – Fine white powder**		**Not applicable**	**2.3 – 2.4**
Vapor Pressure (mm)	Vapor Density (Air = 1)	Evaporation Rate	Boiling Point (°C)	Melting Point (°C)
Not applicable	**Not applicable**	**Not applicable**	**Not applicable**	**Not applicable**
Solubility in Water (20°C)	Volatiles (% by volume)	pH (25 °C)	Bulk Density (kg/m^3)	Coefficient of water/oil distribution
0.165g/100g Sat.soln	**Not applicable**	**Sat. soln $Ca(OH)_2$ 12.45**	**320 - 690**	**Not applicable**

SECTION IV - FIRE OR EXPLOSION HAZARD DATA

Flammability

Yes ☐ No ☑ If yes, under which conditions?

Extinguishing Media

Calcium Hydroxide does not burn. Use extinguishing media appropriate to surrounding fire conditions.

Special Fire Fighting Procedures

Not applicable

Flash point (° C) and Method	Upper flammable limit (% by volume)	Lower flammable limit (% by volume)
Not applicable	**Not applicable**	**Not applicable**
Auto Ignition Temperature (°C)	TDG Flammability Classification	Hazardous Combustion Products
Not applicable	**Non-flammable**	**None**

Dangerous Combustion Products **None**

EXPLOSION DATA

Sensitivity to Chemical Impact	Rate of Burning	Explosive Power	Sensitivity to Static Discharge
Not applicable	**Not applicable**	**Not applicable**	**Not applicable**

SECTION V - REACTIVITY DATA

Chemical Stability Yes ☐ No ☑	If no, under which conditions?	**Absorbs carbon dioxide in the air to form calcium carbonate.**
Incompatibility to other substances Yes ☑ No ☐	If so, which ones?	**Boron tri-fluoride, chlorine tri-fluoride, ethanol, fluorine, hydrogen fluoride, phosphorus pentoxide; and acids (violent reaction with generating heat and possible explosion in confined area).**
Reactivity Yes ☑ No ☐	If so, under which conditions?	**Reacts violently with strong acids. Reacts chemically with acids and many other compounds and chemical elements to form calcium based compounds. Explosive when mixed with nitro organic compounds.**
Hazardous Decomposition Products		**Thermal decomposition at 540°C will produce calcium oxide and water.**
Hazardous Polymerization Products		**Will not occur.**

SECTION VI - TOXICOLOGICAL PROPERTIES

Route of Entry

☑ Skin Contact ☐ Skin Absorption ☑ Eye Contact ☑ Acute Inhalation ☐ Chronic Inhalation ☑ Ingestion

Effects of Acute Exposure to Product

Skin	**Severe irritation of mucous and skin, removes natural skin oils.**
Eyes	**Severe eye irritation, intense watering of the eyes, possible lesions, possible blindness when exposed for prolonged period. Eye-Rabbit-10mg/ 24 h – Severe.**
Inhalation	**If inhaled in form of dust, irritation of breathing passages, cough, sneezing.**
Ingestion	**If ingested: pain, vomiting blood, diarrhea, collapse, drop in blood pressure (indicates perforation of esophagus or stomach).**

Effects of Chronic Exposure to Product:

Contact dermatitis. Following repeated or prolonged contact, this product can cause redness, desquamation and fissures. This product may contain trace amounts of crystalline silica. Excessive inhalation of respirable crystalline silica dust may result in respiratory disease, including silicosis, pneumoconiosis and pulmonary fibrosis.

LD_{50} of Product (Specify Species and Route) **(Food grade $Ca(OH)_2$: 7340mg/kg) (Rats, ingestion)**	Irritancy of Product **Severe to moist tissues**	Exposure limits of Product **Unavailable**
LC_{50} of Product (Specify Species) **Unavailable**	Sensitization to Product **None**	Synergistic materials **None reported**

SECTION VI - TOXICOLOGICAL PROPERTIES (Cont'd)

☑ Carcinogenicity ☐ Reproductive effects ☐ Tératogenicity ☐ Mutagenicity

Calcium Hydroxide is not listed as a carcinogen by ACGIH, MSHA, OSHA, NTP or IARC. It may, however, contain trace amounts of Crystalline Silica listed carcinogens by these organizations.

Crystalline Silica, which inhaled in the form of quartz or crystobalite from occupational sources, is classified by IARC as (Group 1) carcinogenic to humans.

Silica, crystalline (Airborne particles of respirable size) is regulated under California's Safe Drinking Water and Toxic Enforcement Act of 1986. (Proposition 65).

NIOSH considers crystalline silica to be potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

NTP lists respirable Crystalline Silica as known to be human carcinogens based on sufficient evidence of carcinogenicity in humans.

ACGIH lists respirable Crystalline Silica (quartz) as suspected human carcinogen (A-2).

RSST lists respirable Crystalline Silica (quartz) as suspected human carcinogen.

SECTION VII - PREVENTIVE MEASURES

Personal Protective Equipment (PPE) **Wear clean, dry gloves, full length pants over boots, long sleeved shirt buttoned at the neck, head protection and approved eye protection selected for the working conditions.**

Gloves (Specify)	Respiratory (Specify)	Eyes (Specify)	Footwear (Specify)
Gauntlets Cuff style	**NIOSH approved (N/R/P95) dust respirator**	**ANSI, CSA or ASTM approved safety glasses with side shields. Tight fitting dust goggles should be worn when excessive (visible) dust conditions are present. Do not wear contact lenses without tight fitting goggles when handling this chemical.**	**Resistant to caustics**

Clothing (Specify)	Other (Specify)
Fully covering skin	**Evaluate degree of exposure and use PPE if necessary. After handling lime, employees must shower. If exposed daily, use oil, Vaseline, silicone base creme etc. to protect exposed skin, particularly neck, face and wrists.**

Engineering Controls (e.g. ventilation, enclosed process, specify)

Enclose dust sources; use exhaust ventilation (dust collector) at handling points, keep levels below Max. Concentration Permitted.

SECTION VII - PREVENTIVE MEASURES (Cont'd)

Leak and Spill Procedure

Limit access to trained personnel. Use industrial vacuums for large spills. Ventilate area.

Waste Disposal

Transport to disposal area or bury. Review Federal, Provincial and local Environmental regulations.

Handling Procedures and Equipment

Avoid skin and eye contact. Minimize dust generation. Wear protective goggles and in cases of insufficient ventilation, use anti-dust mask. An eye wash station and safety shower should be readily available where this material or its water dispersions are used. Contact lenses should not be worn when working with this chemical.

Storage Requirements

Keep tightly closed containers in a cool, dry and well-ventilated area, away from acids. Keep out of reach of children.

Special Shipment Information

Calcium Hydroxide is neither regulated by the Transportation of Dangerous Goods (TDG) Regulations (Canada) nor by the Hazardous Materials Regulations (USA).

SECTION VIII - FIRST AID MEASURES

Skin

Carefully and gently brush the contaminated body surfaces in order to remove all traces of lime. Use a brush, cloth or gloves. Remove all lime-contaminated clothing. Rinse contaminated area with lukewarm water for 15 to 20 minutes. Consult a physician if exposed area is large or if irritation persists.

Eyes

Immediately rinse contaminated eye(s) with gently running lukewarm water (saline solution is preferred) for 15 to 20 minutes. In the case of an embedded particle in the eye, or chemical burn, as assessed by first aid trained personnel, contact a physician.

Inhalation

Move source of dust or move victim to fresh air. Obtain medical attention immediately. If victim does not breathe, give artificial respiration.

Ingestion

If victim is conscious, give 300 ml (10 oz) of water, followed by diluted vinegar (1 part vinegar, 2 parts water) or fruit juice to neutralize the alkali. Do not induce vomiting. Contact a physician immediately.

General Advise

Consult a physician for all exposures except minor instances of inhalation.

SECTION IX - REGULATORY INFORMATION

Superfund Amendments and Reauthorization Act of 1986 (SARA Title III). / The Emergency Planning and "Community Right-to-Know" Act (EPCRA). / Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). / Resource Conservation and Recovery Act (**RCRA**).

Component Calcium Hydroxide has been reviewed against the following regulatory listings:

- **SARA Section 302 – Emergency Planning Notification. Extremely Hazardous Substances (EHS) List and Threshold Planning Quantity (TPQ). (40 CFR, Part 355, Section 30) : Not listed.**
- **SARA Section 304 – Emergency Release Notification. Extremely Hazardous Substances (EHS) and Reportable Quantity (RQ) List. (40 CFR, Part 355, Section 40) : Not listed.**
- **SARA Section 311/312 – Hazard Categories (40 CFR, Part 370) : This product is regulated under CFR 1910.1200 (OSHA Hazard Communication) as Immediate (Acute) Health Hazards – Irritant.**
- **SARA Section 313 – Toxics Release Inventory (TRI). Toxic Chemical List (40 CFR, Part 372). Not listed.**
- **CERCLA – Hazardous Substance (40 CFR, Part 302): Not listed in Table 302.4.**
- **RCRA – Hazardous Waste Number (40 CFR, Part 261, Subpart D): Not listed.**
- **RCRA – Hazardous Waste Classification (40 CFR, Part 261, Subpart C): Not classified.**

CWA 311. - Clean Water Act List of Hazardous Substances.

Calcium Hydroxide has been withdrawn from the Clean Water Act (CWA) list of hazardous substances. (11/13/79) (44FR65400)

California Proposition 65.

Component Calcium Hydroxide does not appear on the above regulatory listing. This product may contain small amounts of crystalline silica. Silica, crystalline (Airborne particles of respirable size) is regulated under California's Safe Drinking Water and Toxic Enforcement Act of 1986. (Proposition 65)

Transportation - Hazardous Materials Regulations (USA) & Transportation of Dangerous Goods (TDG) Regulations (Can).

Calcium Hydroxide does not appear on the above regulatory listings

Toxic Substances Control Act (TSCA).

All naturally occurring components of this product are automatically included in the USEPA TSCA Inventory List per 40 CFR 710.4 (b). All other components are one the USEPA TSCA Inventory List. Calcium Hydroxide is exempt from reporting under the inventory update rule.

Canadian Environmental Protection Act (CEPA) – Substances Lists (DSL/NDSL).

Calcium Hydroxide appears on the Domestic Substances List (DSL).

ANSI/NSF 60 - Drinking Water Treatment Additives.

Hydrated Lime has been investigated with respect to elements identified by EPA as toxic and it has been classified for use in direct contact with drinking water. (in accordance with Standard ANSI/NSF 60). For a list of classified products, refer to Underwriters Laboratories Inc.'s Online Certifications Directory.

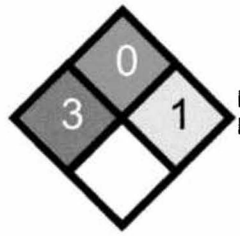
FDA - U.S. Food and Drug Administration, Department of Health and Human Services.

Calcium Hydroxide has been determined as "Generally Recognized As Safe" (GRAS) by FDA. See 21CFR184.1205. (CFR Title 21 Part 184 - - Direct food substances affirmed as generally recognized as safe).

SECTION X - OTHER INFORMATION

Hazardous Materials Identification System (U.S.)

National Fire Protection Association (U.S.)



WHMIS – Classification:	WHMIS – Classification:
"E" Corrosive Materials.	**"D2A" and "D2B" Materials causing other toxic effects.**

Symbol:

Symbol:

Additional Information/Comments:

The technical data contained herein is given as information only and is believed to be reliable. GRAYMONT makes no guarantee of results and assumes no obligation or liability in connection therewith.

Sources Used:

NFPA, NLA, TDG, CSST, RSST, (LSRO-FASEB), Hazardous Products Act, Environment Canada, Enviroguide, OSHA, ACGIH, IARC, NIOSH, CFR, NTP, HSDB, EPA SRS, Chemistry and Technology of Lime and Limestone (John Wiley and Sons, Inc.), Lime and Limestone (WILEY-VCH).

SECTION XI - PREPARATION INFORMATION

Prepared by:	Telephone number:	Date :
GRAYMONT (QC) INC. **Technical Services**	**(450) 449-2262**	**September 2006**

An electronic version of this MSDS is available at: www.graymont.com under the PRODUCTS section.

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 6

Description of lime treatment system and proposed schedule for construction and operation

Proposed Lime Treatment System

Lime Addition

A new hydrated lime facility will be constructed to add lime to the tunnel discharge upstream of the first settling ponds. Lime would be added continuously and at a rate proportional to incoming flow at a capacity capable of attaining a pH of 9.0 to 9.5 ahead of the first treatment pond. Additional details concerning treatment system components, function and operations will be provided as the design process moves forward.

Based on extended bench-scale testing, it appears that regardless of the pH after initial adjustment, the pH of the treated flow will decline over time as treated water flows through the Ponds System to a pH level near 8.0 within a four day period, dropping more quickly when the initial pH was at 9.0 than at pH 9.5.

Maximum lime feed capacity will be based on the maximum documented peak discharge from the tunnel of 2200 gpm. Based on current treatability study information, lime feed would be assumed at a range of 30 mg/l to 150 mg/l. The maximum feed rate assuming dosage rates based on adjusting to a pH of 9.5 would equate to 3960 pounds per day of lime at a peak discharge rate of 2200 gpm from the tunnel. Lime dosing capacity will provide for anticipated flow ranges from as low as 300 gpm to a high of 2200 gpm.

Settling and Solids Removal

Due to site constraints including steep topography and limited open area it will be necessary to maximize use of available space. This includes optimizing use of available solids settling area. Even though there are currently nine ponds in the active flow system (out of a total of 18 active, bypassed or abandoned ponds in the overall system), relatively few ponds will be required to provide reliable solids settling for treatment purposes. Specifically, one pond will likely settle over 90-95 percent of the solids, with the remainder of the ponds providing backup settling or “polishing” of the effluent. Initial settling of solids will take place in the ponds downstream from the point of lime addition, principally in the most upstream pond. Periodically (on the order of once per two to three-year period) solids will be consolidated in the uppermost pond to reduce the solids volume and restore a portion of the settling volume. During the period when solids are being consolidated (approximately one to two months), it will be necessary to divert the flow from the primary settling pond to the second pond in series, which will provide primary settling. Surface water will be decanted in the uppermost pond. Ongoing seepage and evaporation in the absence of treated water influent will allow the consolidated solids to dewater. As discussed in Attachment 13, existing information indicates that seepage flows would re-emerge as surface water and reach the Dolores River adjacent to or within close proximity downstream of the Ponds System. Bench scale testing has indicated that consolidation in this manner should reduce the settled solids volume to approximately fifty percent of its initial volume (doubling the density of the settled solids to approximately twenty percent solids by weight). Over time (approximately every two to three consolidation cycles) the portion of the pond volume available for settling will decrease to the point it becomes necessary to remove the consolidated solids from the pond and fully restore its initial settling volume.

Two options are being considered for the sequence of the settling ponds: Option 1 will use the existing ponds with Pond 18 being the initial pond, followed by Ponds 15, 14, 12, 11, etc. to Pond 4 and then discharge. Option 2 would include a newly constructed pond, Pond 16/17 followed by the same sequence as Option1. There are advantages and disadvantages to each option which will be evaluated in the design phase.

Initial Solids Removal

A portion or all of the accumulated solids from the uppermost ponds (Ponds 18, 15, 14, and possibly also 12 and 11) would be removed, and/or additional upstream detention would be provided to enable full detention, settling of treated solids and effluent polishing within the Ponds System. The volume of the Ponds System in an empty condition with all solids removed from Ponds 11 through 18 and with Pond 16/17 (if implementing Option 1) and Pond 10 added to the system is estimated to be 3,330,000 cubic feet (76.6 acre ft). Solids are presently estimated to occupy approximately 24 acre-feet of the total volume. By removing the solids and adding Pond 16/17 and Pond 10, the effective settling volume will be increased significantly. With all solids removed, the Ponds System would provide a detention time of 16.5 days at the average annual influent rate (1050 gpm) and 8 days at the peak historic spring rate (2200 gpm).

Polishing

The lower ponds (below Pond 15) in the existing system have little accumulated solids and have developed wetlands which may help improve treated water quality. The existing ponds will be maintained on the hydraulic flow path to take advantage of this passive treatment and provide a buffer against upset conditions in the upper ponds.

Automated Monitoring System

Automated monitoring and recording of the following parameters would be provided:

- Flow discharged from the tunnel
- Flow from the final outfall into the Dolores River
- pH of effluent from the uppermost pond and the Ponds System effluent
- Lime feed rate

Remote access to the monitoring data will be installed. Automatic flow proportional lime slurry feed would be provided based on the flow discharge from the tunnel, and an operator dosage selection. Specific methods and other details of remote monitoring will be evaluated in terms of need, technical feasibility, reliability and cost.

Proposed Ponds System Design, Construction and Operation Schedule

		Proposed Completion
1.	Data collection, additional sampling and supplemental submittals	6/1/2012
2.	Completion of final design	6/15/2012
3.	Construction contract award	12/1/2012
4.	Initiation of system construction	4/1/2013
5.	Completion of system construction	12/31/2014
6.	System start-up and shakedown	9/30/2015
7.	Full operation of system	10/1/2015

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 7

Average flows and treatment

Average Flows

Outfall Number	Wastewater Source	Treatment Used	Avg Flow MGD	Design Flow MGD	Daily Max Flow MGD
001 to Dolores River	St. Louis Tunnel Effluent	Lime addition	1.53	3.46	3.17
	Exploratory drill hole leakage	None	0.01	0.01	0.01
	Storm Water (direct precipitation into ponds)	None	.02		.03

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 8

Discharge quality of effluent

Table 8-1 lists historic data from analysis of the existing ponds system discharge and predicted effluent quality from the proposed ponds system. Historic data is for the period 1999 to 2006 during which time tunnel discharge was circulated through certain of the ponds but there was no lime treatment. Instream water quality data for both above and below the discharge are provided in the Water Quality Assessment (WQA) in Attachment 15.

Predicted effluent quality provided in the table is based on the historic data, treatability studies conducted during the period of 2001 through 2006, assumptions of how the ponds system would be operated and the effect of lime addition on the concentration of the various parameters. A series of ten bench-scale tests were conducted at an initial pH from lime addition of between 9.0 and 9.5. The treatability studies showed a range of potential effluent quality, which was considered in developing the table. It was assumed that the system would likely be operated at the higher pH during critical portions of the year to assure compliance with treatment standards.

Predicted effluent quality was compared to water quality based standards, antidegradation based limits, and expected/preliminary effluent limits. Predicted effluent quality shows compliance with preliminary effluent limits and antidegradation based limits assuming that the system is operated at higher pH levels during critical periods of the year.

In order to confirm that the system water quality has not changed since the earlier testing, additional sampling and analysis of tunnel discharge, ponds system discharge and river water quality will be performed prior to completion of final design. This data will be provided to the Division to supplement this application and update the WQA, as appropriate. Additional treatability testing may also be conducted to finalize system design.

Attachment 8 - Discharge Quality of Effluent

PARAMETER	UNIT	Detection	Historic - 1999-2006 Min	Max	Average	# samples	Predicted Effluent Min	Max	Average
Total Dissolved Solids	mg/l	10	940	1350	1124	19	800	1350	1000
Flow	MGD	N/A	0.08	1.69	0.7	48	0.1	3.2	1.5
pH	s.u.	N/A	6.65	7.57	7.1	12	7	9	8
Oil and Grease	mg/l	5							
Dissolved Oxygen	mg/l	N/A					4	8	6
Alkalinity	mg/l	2	97	219	145	16	70	220	150
Total Suspended Solids	mg/l	5	0	16	4	19	0	30	10
Hardness	mg/l as $CaCO_3$	1	654	925	797	18	500	925	700
Total Ammonia	mg/l as N	0.05							
Temperature	DegC Winter	N/A	0.5	1.9	1	6	0.5	2	1
Temperature	DegC Summer	N/A	11.2	18	14.5	4	11	20	15
Biochemical Oxygen Demand	mg/l	1							
Chemical Oxygen Demand	mg/l	30							
Dissolved Aluminum	mg/l	0.1							
Total Arsenic	ug/l	0.5	0	0	0	4	0	3	1
Total Recoverable Cadmium	ug/l	0.1	5.5	82.2	18.3	14	0	7	3
Hexavalent Chromium	ug/l	0.1	0	0	0	4	0	5	2
Trivalent Chromium	ug/l	0.1	0	1.6	0.15	15	0	3	1
Total Chromium	ug/l						0	5	2
Total Recoverable Copper	ug/l	1	0	30	8.8	19	0	15	4
Potentially Dissolved Copper	ug/l	1	0	20.4	8.1	17	0	15	4
Total Recoverable Iron	ug/l	10	220	1410	696	20	0	1000	250
Dissolved Iron	ug/l	10	0	1440	154	19	0	1000	100
Total Recoverable Lead	ug/l	0.1	0.2	4.4	1.4	14	0	4	0.4
Potentially Dissolved Lead	ug/l	0.1	0	32	2.7	15	0	5	0.5
Total Phenols	mg/l	0.1							
Total Organic Nitrogen	mg/l	1.0							
Total Recoverable Manganese	ug/l	5	650	4040	1900	13	150	3000	1400
Dissolved Manganese	ug/l	5	296	4210	1733	19	60	2500	1300
Total Mercury	ug/l	0.0002	0	0.0004	0.0001	11	0	0.0004	0.0001
Total Recoverable Nickel	ug/l						0	100	7
Potentially Dissolved Nickel	ug/l	10	0	80	7.7	13	0	100	7
Total Recoverable Silver	ug/l	0.05	0	0.4	0.04	14	0	1	0.2
Potentially Dissolved Silver	ug/l	0.05	0	0.27	0.0268	19	0	1	0.15
Total Recoverable Uranium	mg/l	0.03							
Total Recoverable Zinc	ug/l	10	1120	14000	3364	14	20	850	375
Potentially Dissolved Zinc	ug/l	10	410	14500	3304	16	30	800	375
Total Residucal Chlorine	mg/l	0.05							
Fecal Coliform	#/100ml	N/A							
Nitrate	mg/l as N	0.1							
Nitrite	mg/l as N	0.002							
Sulfide	mg/l as H_2S	0.1							
Boron	mg/l	0.05							
Choride	mg/l	0.5	0	0.9	0.22	4	0	2	0.2
Sulfate	mg/l	0.5	497	670	578	4	500	800	600
Total Cyanide	ug/l								
Total Recoverable Selenium	ug/l		0	2	0.8	9	0	3	0.5
Total Cobalt	mg/l	0.006							
Gross Alpha	piC/l	0.3							
Total Radium 226 +228	piC/l	8							
Total Fluoride	mg/l	0.1							
Weak Acid Dissociable Cyanide	ug/l	10	0	0	0	6	0	0	0
Total Phosphorus	mg/l	0.05							

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Attachment 9

Dioxin testing

Dioxin Testing

The presence of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCCD) is not expected in any of the wastewater sources or in the final outfall.

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Attachment 10

WET testing and Priority Pollutant Scan

WET testing and Priority Pollutant Scan

The original processes conducted on site and the planned treatment system for the Rico site do not appear on the list of industry categories that are required to conduct WET testing or analyze for organic toxic pollutants found in Appendix A. Although laboratory toxicity tests have been conducted with bench test waters simulating treated effluent, there are currently no existing WET data for the actual treated effluent. Until approximately 1996, WET testing was performed and reported in DMRs submitted to the Division under a previous permit issued for the St. Louis Tunnel discharge.

Besides the discharge quality parameters presented in Appendix 8, the following data is presented for magnesium which appears on the “Metals, Cyanide and Total Phenols” list in Appendix A. This data was analyzed from untreated samples of pond effluent – the addition of lime should decrease magnesium concentrations.

Pond 5 Discharge Data

Date Sampled	Analytical Test	Result (mg/l)
6/27/2001	Dissolved Mg	26.1
6/27/2001	Total Recoverable Mg	23.5
6/27/2001	Potentially Dissolved Mg	26.1
8/30/2001	Dissolved Mg	24.3
10/18/2001	Dissolved Mg	21.3
7/16/2002	Dissolved Mg	34
10/8/2002	Dissolved Mg	27.4
10/30/2003	Dissolved Mg	28.1
12/2/2003	Dissolved Mg	23.7
1/7/2004	Total Mg	22.2
2/3/2004	Total Mg	23.5
3/2/2004	Dissolved Mg	21.8
4/27/2004	Dissolved Mg	23.4
6/1/2004	Dissolved Mg	30.3
7/6/2004	Dissolved Mg	27.3
12/7/2004	Dissolved Mg	22.3
5/26/2005	Dissolved Mg	30.8
8/2/2005	Dissolved Mg	22.2
1/11/2006	Dissolved Mg	22.3

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Attachment 11

Pollution Prevention Plans

Pollution Prevention Plans

Over decades of site management, there have been various projects to improve flow and quality management. Several projects have been completed to collect and route various flows into the pond system, minimize storm water run-on and eliminate overtopping of pond embankments. The site is inspected on a quarterly basis for general conditions and any indications of structural deterioration or changes in water flows or visible water quality.

When the lime treatment and solids handling systems are in final design, an assessment will be made of the entire pond system to identify additional upgrades.

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Attachment 12

Pond (impoundment) descriptions

Pond (impoundment) descriptions

Overview. The existing ponds have been in place, with some modifications and additions, for as long as 75 years. The upper ponds contain substantial quantities of settled solids from both naturally precipitated metals (primarily iron) and from solids precipitated by lime addition over the period of time when the original facility was operated. The ponds are also unlined and seep a minor portion of their flow to the underlying alluvial aquifer. Embankments of the upper ponds along the Dolores River have been raised and armored with riprap to provide protection against up to the 500-year flood.

Groundwater Quality. The existing ponds do not have installed liners. However, it is likely over time that the ponds have largely been sealed due to the solids accumulation that has not only developed a layer of fine sediment and precipitates on the pond floor but has also penetrated the voids at the contact with the underlying gravel aquifer beneath the ponds. Because the existing ponds do not have installed liners and some (uncertain but small) portion of the water being treated leaks through the pond bottom and enters the groundwater system, it is important to identify if the impact of that seepage is adverse to the groundwater and/or hydraulically connected surface water quality. Installing a liner in the existing ponds would not only be expensive but difficult to accomplish due to the presence of groundwater at or above the level of some of the pond bottoms. Where that condition exists, the groundwater beneath the liner would try to lift it during installation as well as in the future should the pond be dewatered for consolidation of settled solids. Because of this situation, installing a liner in some of the ponds would prevent some of the necessary operations.

Ponds 16/17 are presently not part of the series of ponds receiving flow, and have largely been filled with calcine tailings. The calcine tailings are a fine grained byproduct of the roasting of pyrite ore, and were disposed of in Ponds 16 and 17 as well as in the bottom of Pond 15 (8100 cy of tailings beneath the settled solids), which is presently in the existing flow path. Calcine tailings on site, which are primarily located in the Ponds 16/17 area, are estimated to total 234,000 tons.

Pond Embankments. Based on available data from subsurface exploration (borings and test pits) and associated laboratory testing, it appears that the existing embankments retaining the various ponds at the site were constructed from earth materials available on site. These materials include natural alluvial and colluvial deposits and waste rock from construction of the St. Louis Tunnel. Where explored in the subsurface to date and where visible from the surface, it is apparent that the pond embankments were not designed and constructed to current standards of practice. The fill appears to be heterogeneous with no evidence of intentional zoning (impervious zone, filters, drains, etc.) or placement in controlled lifts. It is unknown if the embankment fill was compacted during placement, and if it was, to what if any standard. Some of the embankments (especially smaller ones) appear to have been placed by dozing or possibly dredging of alluvial materials from the pond area(s) immediately upgradient and/or downgradient. Embankment slopes are typically steep, and in some instances may be at the angle of repose of the material.

All of the existing ponds at the site have been constructed on what was the Dolores River floodplain. The degree or nature of any preparation of the foundations of the embankments, if any, is unknown. Given the geologic environment, it is likely that foundation conditions are highly variable in detail throughout the site and possibly even in the footprint of any given embankment.

Several of the low embankments in the downstream third of the ponds system have been significantly impacted by ongoing beaver activity. These impacts have, in effect, resulted in these embankments taking on the characteristics of beaver dams at least in part with areas containing limbs and branches and packed mud among the typically coarse, granular earth fill. Furthermore, some of these embankments are sufficiently pervious and of sufficiently low height that the head difference between the retained pond upstream and the pond immediately downstream is minimal.

Pond Hydraulics/Structures. Existing hydraulic structures consist of fixed overflow culverts which extend from near the top of an upstream pond to the next pond downstream (generally discharging above the downstream ponds' water surface) and/or overflow sections which permit flows to discharge near the top of the embankment without eroding it and causing failure. In the case of the culverts, the overflow section of the culvert acts as the level control for the pond. Additional overflow sections have been added as a temporary measure over the past few years following situations where the embankments were nearly overtopped. Beaver activity in various ponds have been a concern in that the beavers have frequently been effective at damming up a pond's outlet conduit, again causing the pond water level to rise to unsafe levels. Existing culverts and overflow sections do not have specific hydraulic design capacities. No low-level outlets are provided to enable drawing a pond down without pumping. Also, bypass piping to enable diversion of flow around a given pond while performing maintenance/cleaning was not provided in the original design and construction of the ponds system.

If some of the ponds and their embankments are determined to be jurisdictional under the State Engineer's dam safety rules and regulations, specific improvements may be required in order to comply with the regulations. This could include providing low-level outlet works and capacity to route an appropriate design flood through the system.

Planned Upgrades to Pond System

Utilize Existing System to the Maximum Degree Practical. This includes retention of the majority of the existing ponds and embankments, reinforcement and/or upgrading of embankments as necessary to ensure stability, replacement of most hydraulic structures, consolidation and/or removal of a portion of the accumulated solids within the ponds, and provision of bypass piping around each pond or group of ponds. It would also include adding a new treatment pond upstream of Pond 18 in the vicinity of historic Ponds 16/17. Currently off-line Pond 10 could also be brought on-line to add additional detention/polishing.

Pond Embankments. The existing embankments will be retained and rehabilitated as necessary. This mainly requires appropriate geotechnical investigation and analysis to assess the need or absence of need to upgrade the existing embankments. At present, it is envisioned that any necessary upgrades would be constructed on the downstream slopes and at the downstream toes of existing embankments. If deemed necessary, typical measures would likely include: stripping and compacting the existing slope and toe area; placing a filter blanket and if necessary an overlying drainage blanket on the prepared stripped surface; and placing fill as necessary to protect the filter/drain zones and to meet required factors of safety against downstream slope failure under appropriate loading conditions. If necessary and appropriate, consideration would also be given to providing drainage relief and/or piping protection in the downstream toe foundations.

Pond 16/17 Embankment. A new embankment will be constructed around the current Pond 16/17 calcine tailings area to create the new primary settling pond. Foundation improvements would be designed and constructed if/as necessary (e.g., removing locally unsuitable material;

providing for pore pressure relief and/or piping protection). The embankment would be constructed using standard design measures and construction methods appropriate to the borrow materials available to provide for slope and foundation stability, seepage control, and protection against internal erosion (piping).

Hydraulic Structures. New outlet structures and overflow spillways will be provided in each of the major ponds (Ponds 11, 15, 16/17 and 18) and Pond 10 if it is added to the flow path. Outlet structures will be provided with adjustable overflow weirs to regulate pond level. An emergency overflow spillway (independent of the outlet structure) will also be provided to handle excess flows or in the event that the normal outlet structure should become plugged. Bypass piping will be provided to enable bypassing of the subsequent downstream pond. Structures will be designed in accordance with Office of the State Engineer’s dam safety rules and regulations.

Lining/Groundwater Protection. Experience and relevant science have shown that wet closure of tailings (by continuous inundation) which deprives the metals of air and places them in a reducing state minimizes sulfide oxidation and acid production thereby minimizing release of dissolved metals to the groundwater. Available data suggest that the Ponds 16/17 area presently has an adverse affect on area groundwater quality. It is believed that converting the area to an unlined pond that effectively wet closes the calcine tailings and adds high pH water to the groundwater will have a beneficial impact on groundwater quality within the site. The same beneficial condition has presumably been occurring historically in Pond 15.

No additional lining/sealing of the ponds is proposed. The existing ponds are naturally sealed, by sediment deposition and precipitation of minerals, to the extent that significant loss of water from the treatment process is not occurring. Care would be exercised while removing solids from the existing ponds to not significantly damage the existing seal.

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Attachment 13

Geology/hydrology summary

Attachment 13

St. Louis Ponds
CDPS Discharge Permit Application

1.0 Geology

The geology at the site of the proposed water treatment system at the St. Louis Ponds is described in the following subsections. Figures 13-1A through 13-1D illustrate the distribution of bedrock, surficial deposits, and geologic structure in plan and section. This mapping is based on available published geologic mapping, review of color aerial photographs of the site area, reconnaissance mapping of the site, compilation of previous and recent subsurface exploration at the site (including boring and test pit logs), and review of relevant geotechnical testing data on samples from the site. Logs of the borings and test pits and the results of geotechnical testing relevant to this study are included in Appendix A.

1.1 Bedrock

The bedrock underlying the proposed water treatment system site is comprised mainly of the Middle Pennsylvanian-age (240-250 million years old) Lower Member of the Hermosa Formation and local volcanic intrusions of Late Cretaceous to Lower Tertiary-age (about 65 million years old) hornblende latite porphyry. The Hermosa rocks are generally described as follows:

> *"greenish-gray buff-weathering micaceous sandstone, siltstone, and arkose, locally conglomeratic, black and gray shale, and minor dark-gray limestone or dolomite; sandstone and arkose massively bedded or crossbedded, siltstone and shale thin bedded and slabby"* (Pratt, et al., 1969)

The estimated total thickness of this unit in the region is greater than 880 feet. Although only locally exposed in the slope above the site to the east, some additional information on the nature of the Hermosa is available from geologic logs of the St. Louis tunnel complex (McKnight, 1974). These logs show the presence of several intervals of younger hornblende latite porphyry that has intruded the older Hermosa sedimentary rocks. Areas of outcropping latite porphyry are locally present on the lower slope of CHC Hill adjacent to the site to the east (see Figures 13-1B and 13-1C). The hornblende latite porphyry is described as follows:

> *"Abundant white plagioclase crystals in altered groundmass which ranges from light to dark gray, greenish gray, or brownish gray, depending on abundance of chlorite and iron oxides as alteration products. Forms sills and small laccoliths a few feet to several hundred feet thick and dikes a few feet to several tens of feet wide, throughout the Rico Mountains."* (Pratt, et al., 1969)

The bedrock at the site is only of indirect significance to the proposed siting and design of the water treatment system, being the primary source of the generally thick cover of talus/slopewash (or colluvial) soils in the lower slopes to the east of and underlying the eastern portions of the site, and a minor contributor to the generally shallower alluvial deposits. As shown on Figures 13-1B and 13-1C, the only surface exposures of bedrock near the primary treatment facilities are about 300 feet upslope; bedrock crops out or is only shallowly buried in the slopes above the lower portion of the site (including at the groundwater choke point discussed below). The St. Louis tunnel geologic logs noted previously suggest that bedrock may be as deep as about 250-300 feet into CHC Hill along the tunnel alignment (see Figure 13-1D). The only boring on site that reportedly encountered bedrock (weathered sandstone) was B-5 at a depth of 29.5 feet.

1.2 Structure

The Rico area lies at the center of a geologically young structural uplift that occurred about 65 million years ago during a period of widespread crustal deformation known as the Laramide Orogeny. A structural dome about 10 miles across and with a vertical relief of over a mile formed centered over the south end of the St. Louis Ponds site. This is evidenced by the exposure of very old bedrock (greenstone) in the lower hill slopes on both sides of the Dolores River in the vicinity of the Highway 145 bridge. Development of this dome was accompanied by extensive faulting that variably offset and fractured all the older major bedrock units, including the Lower Member of the Hermosa Formation. It was during this time that the hornblende latite porphyry intruded the fractured Hermosa rocks.

A much more recent episode of structural and hydrothermal activity occurred in the Rico area about 3-5 million years ago. During this time many of the older bedrock faults were reactivated and ore-bearing hydrothermal fluids moved into the fractured rock, locally resulting in the rich mineralization that characterized the historic Pioneer District.

This history of structural deformation has resulted in the present bedrock structure in the vicinity of the site. The major structural features are the shallow (about 5-15º) bedding dips to the west-southwest in the Hermosa Formation, and a series of small to large bedrock faults ranging from a few feet to over 2000 feet of offset. The closest larger bedrock faults to the site are the east-west trending Nellie Bly Fault that lies beneath the southern portion of the site, and the northeast trending Princeton Fault crossing CHC Hill about 1500 feet southeast of the site. Neither of these, or any of the numerous smaller bedrock faults in the vicinity are active (i.e., capable of generating earthquakes) and thus are of no particular consequence to the site or design of water treatment system facilities.

1.3 Unconsolidated Natural Deposits.

Unconsolidated deposits at and in the immediate vicinity of the proposed water treatment system site include talus/slopewash (colluvium), alluvium, various mining/processing related waste materials, and fill. Subsurface information on these deposits was derived primarily from previous site investigations by Dames and Moore (1981), Colorado Department of Public Health and Environment (CDPHE, 2003), and more recent investigations by SEH and Anderson Engineering (see Appendix A for data from all of these investigations).

Talus/Slopewash. Talus/slopewash (colluvial) deposits are extensive and deep on most of the lower mountain slopes in the Rico area, including on CHC Hill at the St. Louis Ponds site. These deposits were formed by weathering and local gravity movement of the typically fractured and locally altered bedrock previously described. Penetration of these deposits at various locations by mine workings (including on CHC Hill) indicates layers of variable horizontal thickness up to several hundred feet. The colluvium is typically comprised of a wide range of grain sizes from fines (silt/clay) to very large boulders. Crude sorting tends to occur as the colluvial deposits have accumulated by local gravity movement over recent geologic time.

Alluvium. Alluvial deposits are present underlying the relatively flat-bottomed Dolores River valley at the site. Where partially penetrated by borings in the site area and where visible in the current river channel, the alluvium is typically comprised of sand and gravel with abundant cobbles and even some boulders present locally. Given the geologic/geomorphic environment in which these deposits formed, it is very likely that a wide range of grain sizes are locally present within the overall alluvial deposits. These likely range from relatively fine-grained overbank sandy silts/clays to the very coarse channel deposits visible in the active river channel, with lenses of predominantly sand also to be expected. The coarser-grained materials tend to be rounded to subrounded and generally hard and strong as a result of having survived transport from upstream by the inferred much higher energy Dolores River flows in the late Quaternary. The maximum depth of alluvium at the site penetrated by the borings to date is 13 feet in GW4. Although the total depth of alluvium is not known, it is estimated as on the order of 30-40 feet based on the geomorphology of the river valley and experience at other similar sites in the central/northern Rocky Mountains.

Landslides. As shown in part on Figure 13-1B, a major landslide is mapped by McKnight (1974) on the hill slope just to the north of the planned water treatment system facilities, but underlying and immediately upslope of the potential future North Stacked Repository site. This feature is believed to have developed in talus/slopewash (colluvium) and/or weathered sedimentary bedrock on the lower slopes of CHC Hill. Based on observations in historic mine workings north of the site, Ransome (1901) concluded that the slide debris was up to several hundred feet thick. It is possible, if not likely, that this landslide initially formed during a wetter climatic period in the Quaternary (during the last few tens of thousands of years). Erosional undercutting at the base of CHC Hill by a much larger Dolores River flow than at present could have triggered the sliding. Although the repository site itself is not threatened by the presence of this old landslide mass, potential borrow areas along the base of the slopes north of the repository will need to be utilized with caution to avoid locally re-activating this landslide debris. The North Stacked Repository, if constructed, would act as a stabilizing buttress for a portion of the toe of this old slide mass.

Avalanches. There are several historically active avalanche chutes on the lower slopes of CHC Hill (and the adjoining NB Hill to the south) adjacent to and just south of the proposed water treatment system site. The only potential impact to the proposed facilities from activation of any of these known avalanches would be temporary blocking during the winter of access to the site on the gravel road from Highway 145. Appropriate safety and maintenance measures would be implemented to maintain access for site operations during the winter months.

1.4 Artificial Fill and Mining/Mineral Processing Wastes

Artificial Fill. Relatively minor amounts of placed (but not necessarily engineered or controlled) fill are present at and in the vicinity of the water treatment system site. These include remnants of sidehill fill along the now abandoned RGS railroad alignment at the base of CHC Hill and embankments impounding the various ponds at the St. Louis Ponds site.

The Rio Grande Southern Railroad (RGS) mainline followed the lowermost slopes of CHC Hill north of Rico on a cut/fill alignment located above the historic floodplain of the Dolores River along the east boundary of the St. Louis Ponds site (McCoy, et al., 1996). The portal of the St. Louis tunnel is located immediately beneath the abandoned RGS mainline alignment. Although not readily apparent from surface observations, it is likely that at least remnants of the original railroad fill and ballast are present along the alignment. The fill would almost certainly have been derived from local grading of the underlying natural talus/slopewash (colluvium) at the site, and thus be indistinguishable from that parent material. The rails, ties and any high-quality ballast have long since been removed from the site.

Mining/Mineral Processing Wastes. The planned water treatment system facilities are located at the site of historic mining and ore processing activities that occurred sporadically over a period of approximately 80 years (see related discussion in Attachment 14). Deposits of waste rock, calcine tailings, spent ore material, and mining/processing related debris are present at the St. Louis Ponds site as a result of these mining/processing operations.

Waste rock from the original driving and subsequent extension of the St. Louis Tunnel and crosscuts was disposed of locally in the immediate vicinity of the tunnel portal. The currently visible waste rock dump is an arcuate, sidehill deposit approximately 900 feet long, up to 250 feet wide, and up to an estimated 20-30 feet thick.

"Calcine" tailings resulting from sulfuric acid production (derived from roasting pyrite ore/tailings to high temperatures short of melting) were placed in Ponds 15-19 (HRI, 1979). Based on available borings and soundings, these fine- to very fine-grained silty sand tailings deposits are variable in thickness up to at least 22-23 feet. The Pond 16/17 area is also underlain by calcine tailings and Pond 15 has a small layer of calcine tailings beneath the existing settled treatment solids and sediments present from prior water treatment operations.

In the 1980s and 1990s, various reclamation activities decommissioned mining and mineral processing facilities and reclaimed the site.

2.0 Groundwater Hydrology

2.1 Conceptual Groundwater Flow Model

The general groundwater flow system in the area of the St. Louis Ponds is illustrated on Figure 13-2. Figure 13-3 shows an interpretation of average groundwater flow contours based on a series of measurements of groundwater elevations over a period of several years. The following key features of the groundwater system are known or interpreted to exist.

- ***General ground water system*** - The bulk of groundwater flow through the site is dominated by the interactions of the Dolores River with groundwater in the local, essentially isolated alluvial (sand and gravel) aquifer underlying the site area in the locally wider valley reach. This interaction is characterized by: 1) recharge from the river at the upstream portion of the local alluvial aquifer where it becomes wider and thicker; and 2) ground water discharge to the river where the aquifer becomes narrower and thinner. This river/groundwater interaction is supplemented by natural groundwater flows from the hills to the east and west along with St. Louis Tunnel flows, Ponds System seepage and artesian geothermal water from abandoned mineral exploration drill holes. The Dolores River acts as a ground water discharge boundary in general, but is also a recharge boundary during high flows and at the head of valley segments.
- ***Net loss of water from ponds*** - The existing upper St. Louis Ponds have water levels above the river and are known to exhibit a net seepage loss of water, based

on differences in surface water flow measurements at the tunnel and the Ponds System discharge. The net loss is believed to be somewhat constant at about 0.4-0.6 cfs but is likely decreasing over time. This seepage discharges to the underlying shallow alluvial aquifer and then to the Dolores River as described below. Some natural groundwater from the hills immediately east of the site is also inferred to enter the alluvial aquifer underlying the site, flow under the existing ponds, and then discharge to the river adjacent to and just downstream of the site.

- ***Exploratory drill hole contribution*** - At least three leaking, abandoned deep mineral exploration drill holes at the site are a source of natural artesian geothermal groundwater discharging as minor surface flows to one or more of the lower ponds above the Ponds System discharge at Pond 5.
- ***Groundwater "chokepoint" just downstream of the site*** - Based on known site geology, most of the groundwater flow beneath the site (which includes tunnel, pond and natural groundwater contributions) re-emerges as surface water due to a bedrock chokepoint where the valley-side alluvial aquifer pinches out (see Figure 13-2). This chokepoint occurs at a narrow breach in highly erosion-resistant greenstone bedrock that is just downstream of the site (see Figure 13-1C). At this location the valley narrows considerably and the only remaining alluvial deposits are the relatively narrow and shallow channel bed deposits. This results in a much smaller cross-sectional area of alluvial aquifer which forces alluvial groundwater from beneath the site to discharge to the river at or above the chokepoint. This condition is confirmed through flow measurements made at low flows both above and below the ponds site which show a significant gain in river flow (on the order of 2 to 3 cfs in excess of that discharged from the Ponds System). The chokepoint provides an appropriate sampling point to track the long-term effects of these groundwater discharges from the Ponds System to the Dolores River.

2.2 Groundwater Aquifers

The only aquifer underlying the St. Louis Ponds site is the alluvial/colluvial unit on the overbank of the Dolores River. Based on available boring logs and site observations, this aquifer unit is comprised of moderately to very dense, fine to coarse gravel with sand (and locally with clay lenses and layers) estimated at up to 30-40 feet thick. No in-well or aquifer pumping tests have been performed in this unit to date at the site. The permeability of this unit is estimated as averaging on the order of 10^{-2} cm/sec for predominantly sandy alluvium to on the order of 10^{2} cm/sec for gravel-cobble channel deposits based on the apparent gradations of the soils comprising the unit and experience with similar aquifers in geohydrologically comparable settings. The Hermosa Formation underlying the alluvial/colluvial unit is inferred to act as an effective aquitard or aquiclude.

2.3 Groundwater Quality

Groundwater at the St. Louis Ponds site has been investigated and exhibits varying quality both temporally and spatially. This situation exists due to a variety of conditions including buried mine wastes (waste rock, calcine and possibly other tailings and pond solids), presence of discharging geothermal waters from abandoned deep mineral exploration wells, potential seepage from the area of the collapsed reach of the St. Louis Tunnel (that is not intercepted ahead of the Ponds System), recharge from the adjoining heavily mineralized hillside, seepage from the existing ponds, variability of the alluvial aquifer permeability, and seasonal fluctuations in groundwater.

Despite local areas of variable contamination, the groundwater discharged to the Dolores River is believed to meet surface water discharge standards. In addition, the very large majority of flow in the local aquifer beneath the site discharges to the Dolores River at the lower end of the site. Because the groundwater surfaces as it leaves the site, the local on-site groundwater is not believed to impact downstream groundwater quality. Table 13-1 and Table 13-2 list measurements and results of chemical analyses made over the 4-year period 2002-2006.

2.4 Potential Impacts to Downstream Groundwater and Surface Water

To assess the potential impact of seepage from the existing ponds on water quality within the Dolores River immediately adjacent to the St. Louis Ponds site, a mass balance of loading was completed based on measurements made during low river flow conditions. Samples were collected above the Ponds System and immediately above the Ponds System discharge. Measurements of river flow were made at those same locations. The results of mass balance calculations showed that on average the metals with typically elevated concentrations in the tunnel discharge and untreated pond water (i.e., zinc, cadmium and iron) showed no measurable increase within the Dolores River alongside the Ponds System. A measurable increase in manganese was noted in the same reach of the river.

As a further basis of investigating if the site was adversely impacting surface water quality downstream of the treatment ponds, a mass balance of loading and flow from above the entire St. Louis Ponds site to below the site at the chokepoint was completed. This analysis involved calculating instream loading based on flow measurements and metals concentration from sampling completed at low flows. Results from a total of eight sampling events over a five-year period were utilized. These events represented all occasions wherein the river flow was below 15 cfs at the sampling location above the site. Results of the analysis suggest an increase in surface water flow of between two (2) and three (3) cfs due to discharge of groundwater to the Dolores River. The average calculated concentration of the groundwater discharged to the river would meet surface water standards for all parameters reviewed (cadmium, zinc, iron, and manganese). Although the results of metals analysis from several of the monitoring wells on-site showed existing groundwater to have locally high metals concentrations, the mass balance review shows that overall impacts of groundwater discharged to the surface water are not adverse.

Information on domestic wells within one mile of the planned water treatment system at the St. Louis Ponds site is limited. State records show the following wells within a one mile radius of the site (see Figure 13-1E):

- Location: SE1/4 of the SE1/4 of Section 23, T40N R11W – Horse Creek drainage basin at the Ranger Station.
- Location: NE1/4 of the SE1/4 of Section 23, T40N R11W – Horse Creek drainage basin.
- Location: NW1/4 of the SW1/4 of Section 25, T40N R11W – Dolores River basin.

No impacts to these domestic wells are anticipated as they are not completed in the local, isolated alluvial aquifer underlying the site. Restrictions on the use of groundwater for water supply will be implemented at the site.

2.5 References

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Table 13-1
Groundwater Quality Data Summary
(all concentrations in mg/L)

Date	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
Cadmium (dissolved)																
October 2002	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.015		0.007		0.002	
November 2004	0.0002	B					0.0011		0.0033		0.0004	U	0.009		0.0017	B
May 2005	0.0001	B	0.0015		0.0041		0.0001	U	0.0001	U			0.0373		0.0001	B
August 2005	0.0005	U	0.0012	B	0.0011	B	0.0001	U	0.0005	U	0.0005	U	0.0109		0.0002	U
January 2006	0.0001	U			0.001		0.0001	U	0.0005	U			0.0106		0.0001	B
July 2006	0.0001	U			0.0007		0.0001	U					0.0031		0.001	U
January 2007	0.0001	U			0.0004	B	0.0001	U	0.0001	U	0.0001	U	0.006		0.0001	U
Iron (dissolved)																
October 2002	0.16		1.1		0.095		0.3		4.6		630		0.18		41	
November 2004	0.07						0.23		1.42		8.79		2.78		178	
May 2005	0.01	U	0.22		0.01	B	0.45		1.92				1.31		7.09	
August 2005	0.02	U	0.15		0.02	U	0.36		7.57		151		0.13		15.3	
January 2006	0.11				0.02	B	1.24		3.44				9.09		21.9	
July 2006	0.02	U			0.02	B	22.3						0.09		22.3	
January 2007	0.02	U			0.02	U	0.28		3.95		153		8.79		18.3	
Manganese (dissolved)																
October 2002	0.0005	U	2.8		0.43		1.7		4.7		42		0.84		8.1	
November 2004	0.121						0.591		4.38		7.32		2.42		25.4	
May 2005	0.005	U	12.2		0.496		0.7		6.27				2.33		5.24	
August 2005	0.005	U	5.99		0.015	B	0.624		7.85		14.1		0.774		6.13	
January 2006	7.1				16.5		24.8		37.6				39.3		53.5	
July 2006	0.005	U			0.271		7.38						0.866		7.38	
January 2007	0.005	U	0.226		0.568		3.79		20.2		19.2		1.83		6.85	
Zinc (dissolved)																
October 2002	0.012		0.064		0.38		0.073		7.1		4.7		0.67		0.22	
November 2004	0.01	U					0.05	B	7.75		0.23		2.23		9.44	
May 2005	0.01	U	0.22		0.78		0.02	B	17.3				6.51		0.18	
August 2005	0.01	U	0.07		0.31		0.03	B	30.3		17.7		1.83		0.22	
January 2006	0.009	B			0.127		0.505		3.51				2.01		6.45	
July 2006	0.01	U			0.09		0.16						0.44		0.16	
January 2007	0.01	U			0.11		0.01	B	6.29		14.6		1.43		0.17	

U = undetected   B= below practical quantiation level

Table 13-2
Minimum and Maximum Groundwater Concentrations
(all concentrations in mg/L)

Parameter	Analyte Type	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Alkalinity	Total	90	152	216	243	87	192	68	197	96	156	32	150	30	269	4	212
Arsenic	Dissolved	0.0001	0.017	0.001	0.017	0.0005	0.017	0.0004	0.0922	0.015	0.054	0.017	0.291	0.0003	0.017	0.0071	0.22
Arsenic	Total	0.0005	0.0378	0.0012	0.003	0.0005	0.0139	0.0011	0.213	0.071	0.152	0.174	0.429	0.0005	0.016	0.141	0.213
Barium	Total	0.058	0.058	0.067	0.067	0.017	0.017	0.039	0.039	0.019	0.019	0.033	0.033	0.015	0.015	0.03	0.03
Bicarbonate	Unknown	90	152	216	243	87	192	68	197	96	156	32	150	30	269	4	212
Cadmium	Dissolved	0.0001	0.002	0.0012	0.002	0.0007	0.0041	0.0001	0.002	0.0001	0.0033	0.0004	0.015	0.0031	0.0373	0.0001	0.002
Cadmium	Total	0.0001	0.0086	0.0013	0.0016	0.0013	0.0042	0.0001	0.0037	0.0002	0.0369	0.0003	0.0018	0.0036	0.0393	0.0002	0.0045
Calcium	Dissolved	48.2	82.7	215	351	156	224	224	505	573	632	502	502	271	404	405	505
Carbonate	Unknown	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Chloride	Total	0.5	1.3	1.2	2	0.5	5	0	10	0	0.8	0	0.5	0	5	0	5
Chromium	Dissolved	0.0001	0.0005	0.0002	0.0005	0.0001	0.0005	0.0001	0.0005	0.0001	0.0005	0.0005	0.0005	0.0001	0.0002	0.0001	0.001
Chromium	Total	0.0002	0.147	0.0005	0.003	0.0002	0.0015	0.0001	0.0043	0.0003	0.0092	0.0011	0.0011	0.0002	0.0014	0.0002	0.0073
Copper	Dissolved	0.0005	0.003	0.0012	0.004	0.0009	0.003	0.0005	0.0074	0.0005	0.023	0.001	0.005	0.0012	0.0309	0.0005	0.003
Copper	Total	0.0006	0.3	0.0099	0.01	0.003	0.0057	0.0005	0.0099	0.002	0.657	0.009	0.016	0.0041	0.033	0.001	0.043
Cyanide	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyanide	Unknown	0.005	0.005	0.005	0.005	0	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0	0.005
Dissolved Oxygen	Dissolved	0.004	0.73	0	0	0	0	0.0043	0.02	0.001	0.001	0.00097	0.00097	0.00065	0.46	0.0015	0.05
Hardness	Total	146	248	642	1030	458	678	662	1500	1610	1740	1490	1540	820	1260	1200	1630
Hydroxide	Unknown	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Iron	Dissolved	0.01	0.16	0.15	1.1	0.01	0.095	0.23	22.3	1.42	7.57	8.79	630	0.09	9.09	7.09	178
Iron	Total Recoverable	0.05	0.16	0.93	2.14	0.02	0.99	1.6	32.8	6.54	46.1	33.9	168	0.48	14.8	17.5	245
Lead	Dissolved	0.0001	0.014	0.003	0.014	0.0001	0.014	0.0001	0.014	0.0005	0.138	0.0131	0.041	0.0033	0.0293	0.0003	0.048
Lead	Total	0.0001	0.524	0.008	0.0206	0.0005	0.0193	0.0001	0.0871	0.0015	4.43	0.136	0.194	0.0125	0.11	0.0042	0.632
Magnesium	Dissolved	6.2	10	25.5	37.6	16.5	28.8	24.8	58.1	37.6	51.5	56.5	70	34.6	61.4	44.5	126
Manganese	Dissolved	0.0005	0.121	2.8	12.2	0.015	0.496	0.505	7.38	3.51	7.85	7.32	42	0.774	2.42	5.24	25.4
Manganese	Total Recoverable	0.005	48.8	6.22	13.1	0.38	0.965	0.532	6.79	3.51	9.04	7.09	15.2	0.792	2.68	5.08	24.3
Mercury	Dissolved	0.00003	0.0002	0.00003	0.0002	0.00003	0.0004	0.00003	0.0002	0.00003	0.0002	0.00003	0.0002	0.00003	0.0038	0.00003	0.2
Nickel	Dissolved	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.05	0.46	0.01	0.05	0.0006	0.08
Nickel	Total	0.01	0.86	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.05	0.01	0.05	0.0006	0.02
Potassium	Dissolved	0.7	1.7	12.2	16.7	2.7	4.4	1.9	8.4	5.4	6	8.2	25.7	1.9	2.7	6.2	23.5
Selenium	Dissolved	0.0003	0.0007	0.0001	0.0002	0.0005	0.002	0.0001	0.0005	0.0001	0.0006	0.0002	0.0002	0.0004	0.0007	0.0001	0.0005
Selenium	Total	0.0003	0.001	0.0001	0.0001	0.0004	0.0018	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0008	0.0001	0.0005
Silver	Dissolved	0.00005	0.0003	0.0001	0.0003	0.00005	0.0003	0.00005	0.00005	0.00005	0.0003	0.0002	0.0003	0.00005	0.0001	0.00005	0.0002
Silver	Total	0.00005	0.00288	0.00017	0.0007	0.00005	0.0003	0.00005	0.0003	0.0001	0.0167	0.0001	0.0006	0.0001	0.00037	0.0001	0.0017
Sodium	Dissolved	2	4.4	7.9	13.1	3.8	5.7	9.6	11.7	11.2	15	4.2	11.6	6.7	10.3	10.3	10.9
Sulfate	Total	46.9	63.7	534	870	294	555	469	1180	1220	1580	1050	1910	542	1230	880	1190
TDS	Total	170	230	1060	1520	520	920	970	1950	2250	2550	2080	3170	1060	1960	1580	2910
TDS Calc.	Dissolved	160	200	932	1450	586	877	901	1910	2160	2330	2710	2710	1050	1730	1490	1950

Table 13-2
Minimum and Maximum Groundwater Concentrations
(all concentrations in mg/L)

Parameter	Analyte Type	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
TSS	Total	0	103000	6	20	0	26	6	56	5	472	16	82	5	104	5	224
Zinc	Dissolved	0.01	0.012	0.064	0.22	0.09	0.78	0.02	0.16	6.32	30.3	0.23	17.7	0.44	6.51	0.16	9.44
Zinc	Total	0.01	7.14	0.11	0.24	0.14	0.74	0.02	0.29	6.51	36.3	0.39	19.9	0.48	6.59	0.19	9.51

WELLS / BORINGS

- DH-1 (ANDERSON ENGINEERING/SEH, 2008)
- EW-1, EB-1 (SEH, 2004)
- GW1 (CDPHE, 2003)
- B-1 (DAMES AND MOORE, 1981)
- EH-1 (ANACONDA MINERALS)
- DOMESTIC WELL

TEST PITS

- TP-1 (ANDERSON ENGINEERING/SEH, 2008)
- TP-2004A (SEH, 2004)
- TP-A (SEH, 2001)
- APB-1 (ANDERSON ENGINEERING, 1996)

GEOLOGIC UNITS

e	EMBANKMENT FILL, RIPRAP
f	ROAD FILL, PAVEMENT
wr	WASTE ROCK
ct	CALCINE TAILINGS
so	SPENT ORE
f/mw/d	MISCELLANEOUS FILL, MINE WASTE (TAILINGS, WASTE ROCK, ORE), BURIED DEMOLITION DEBRIS
Q_{al}	ALLUVIUM
Q_{f}	FAN DEPOSITS
Q_{tw}	TALUS, SLOPEWASH (COLLUVIUM)
Q_{l}	LANDSLIDE DEBRIS
TK_{lp}	LATITE PORPHYRY INTRUSIVES
P_{cu}	CUTLER FORMATION - SILTSTONE, ARKOSE AND CONGLOMERATE
P_{hl}	HERMOSA FORMATION (LOWER MEMBER) - SANDSTONE, SILTSTONE, SHALE, MINOR LIMESTONE OR DOLOMITE
P_{l}	QUARTZITE
M_{l}	LEADVILLE LIMESTONE
md	METADIORITE
g	GREENSTONE

SYMBOLS

- GEOLOGIC CONTACT
- D / U — BEDROCK FAULT; D * DOWN-THROWN SIDE, U * UP-THROWN SIDE
- 12 — STRIKE AND DIP OF BEDDING
- 65 — TREND AND PLUNGE OF FOLIATION

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GEOLOGIC LEGEND

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FIGURE 13-1A

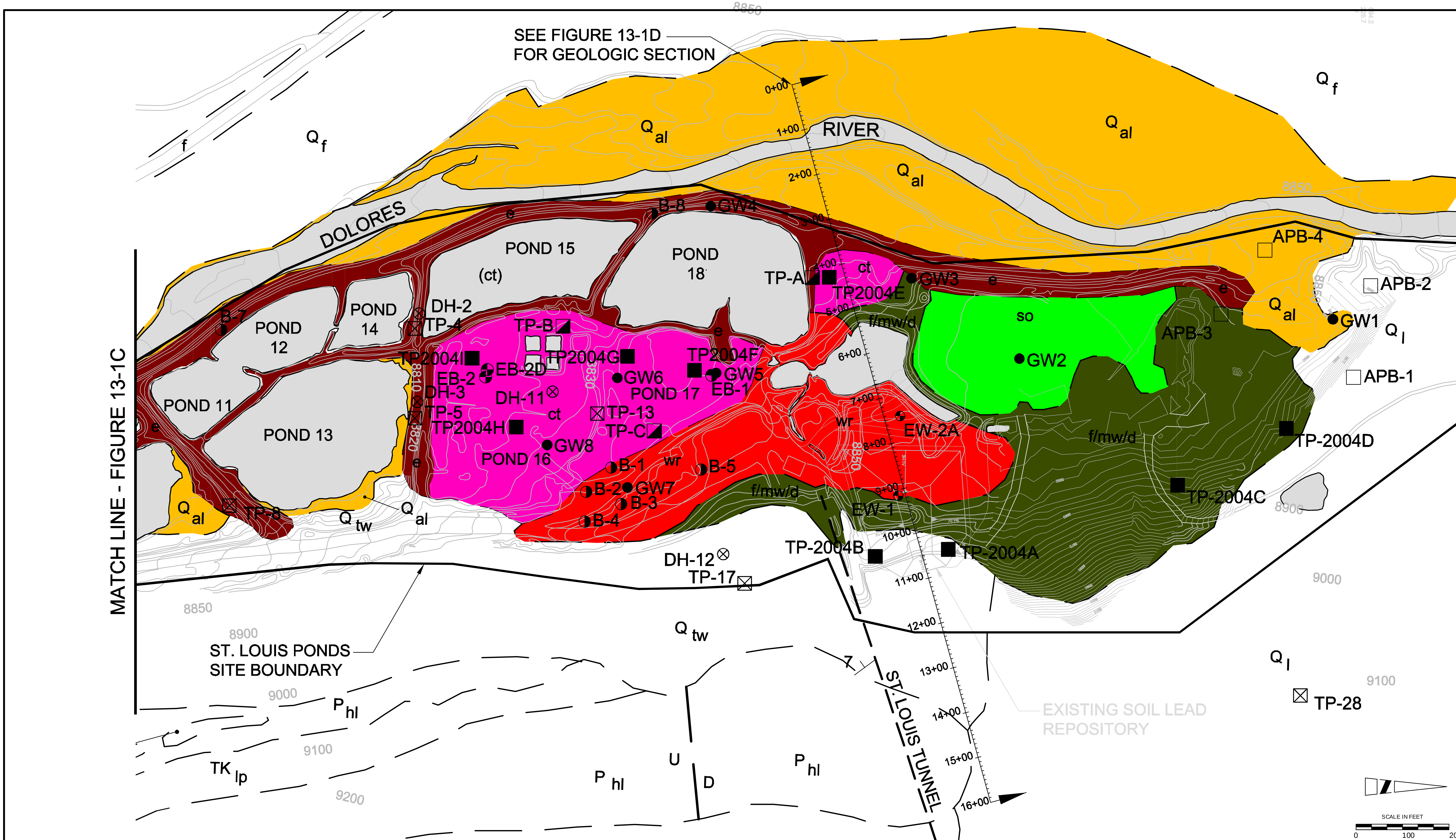

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FIGURE 13-1B

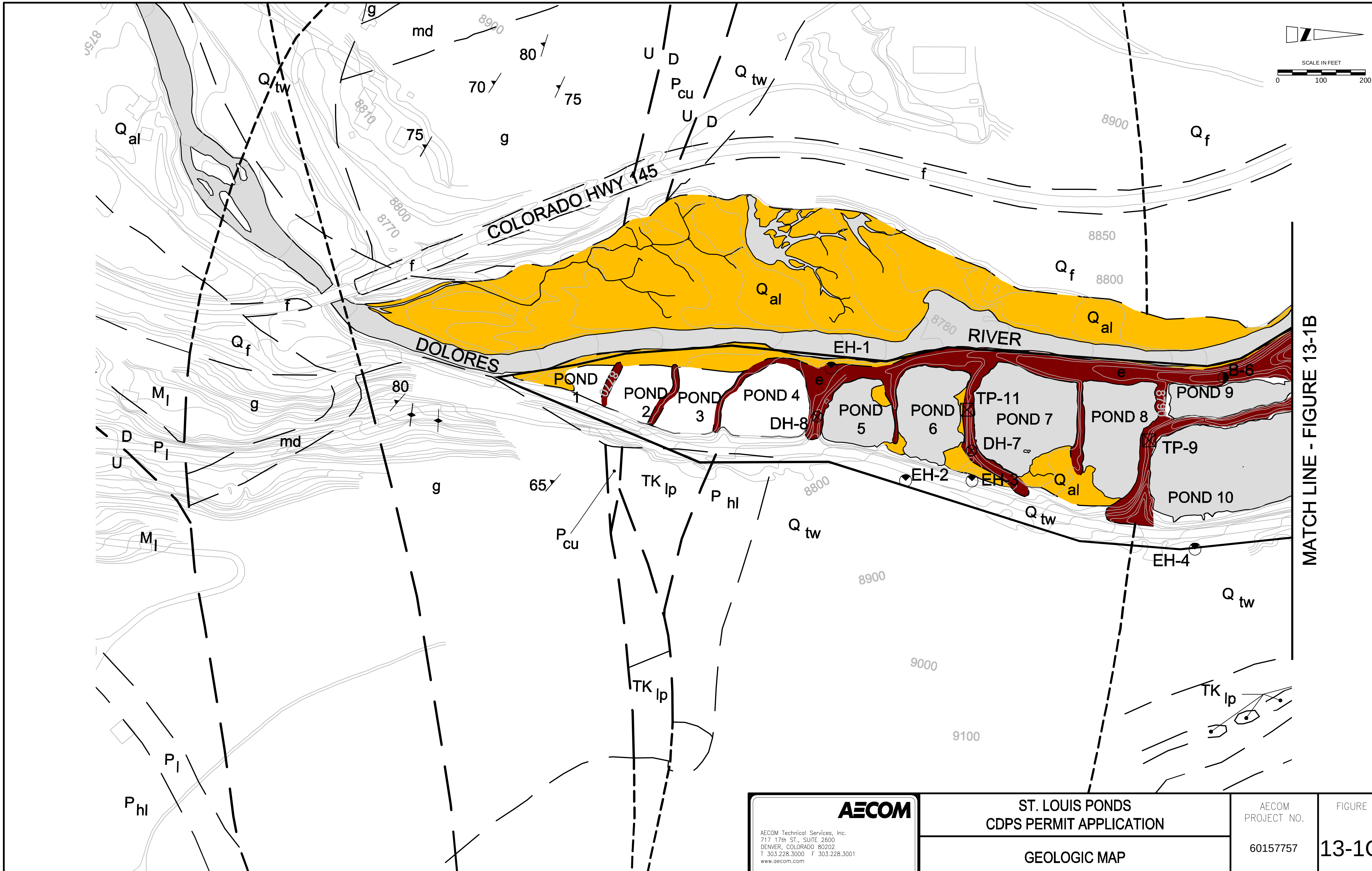

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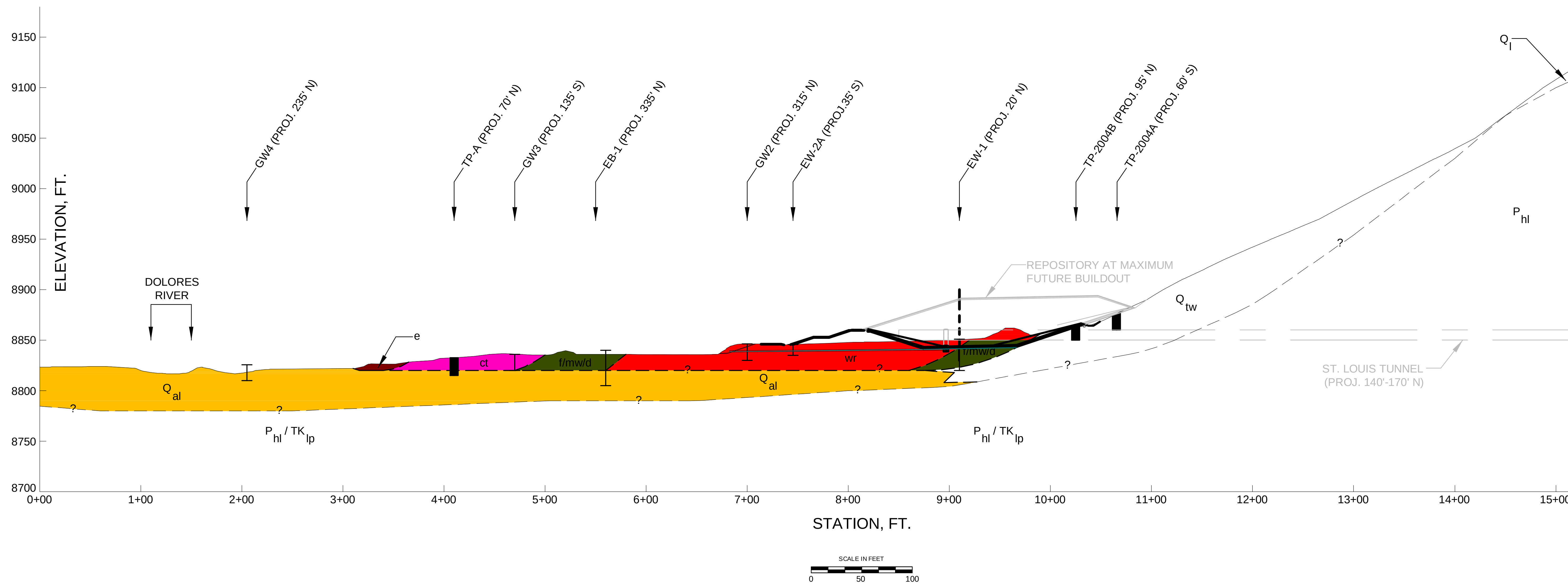
FIGURE 13-1C



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GEOLOGIC SECTION

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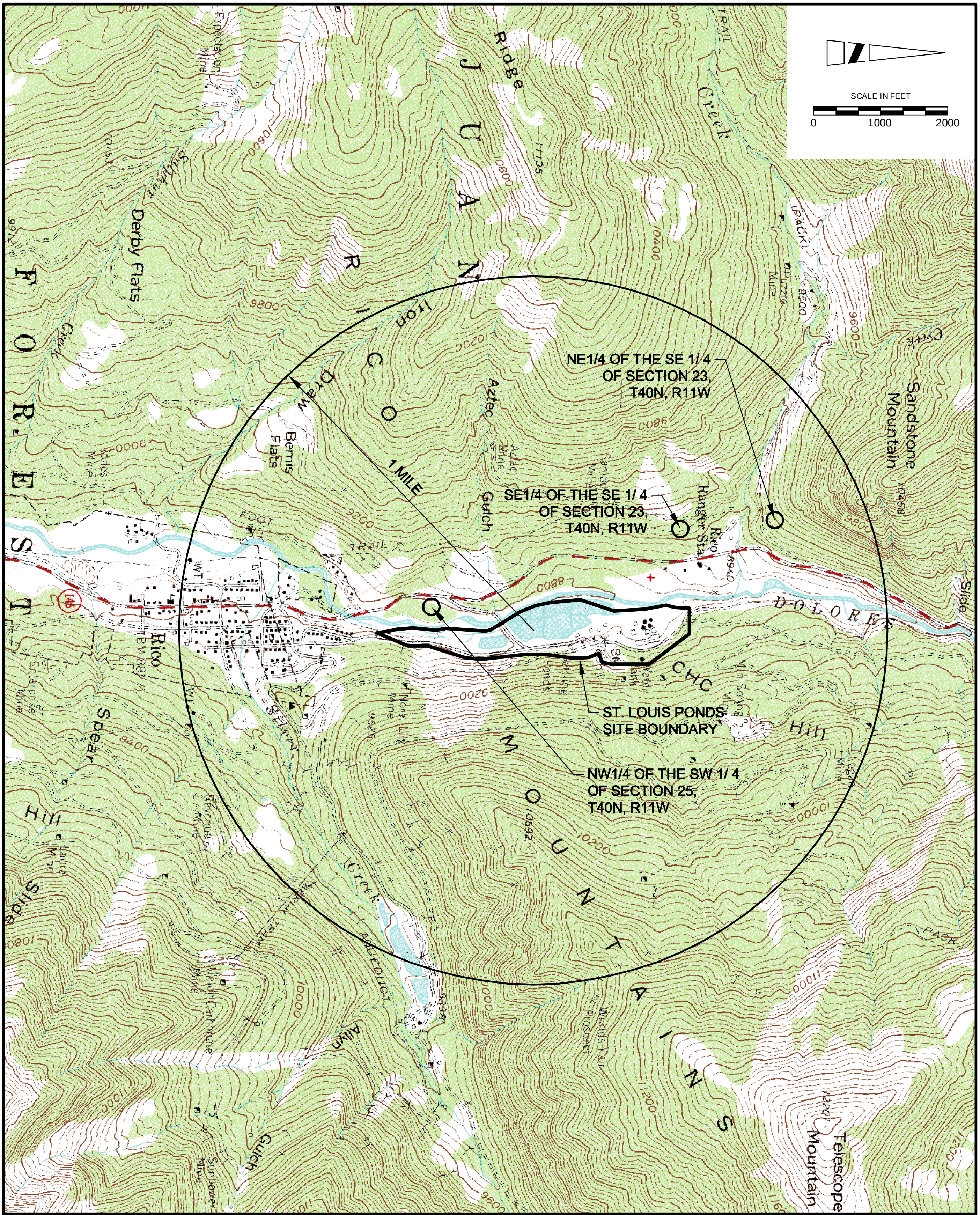
FIGURE 13-1D



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DOMESTIC WELL LOCATIONS

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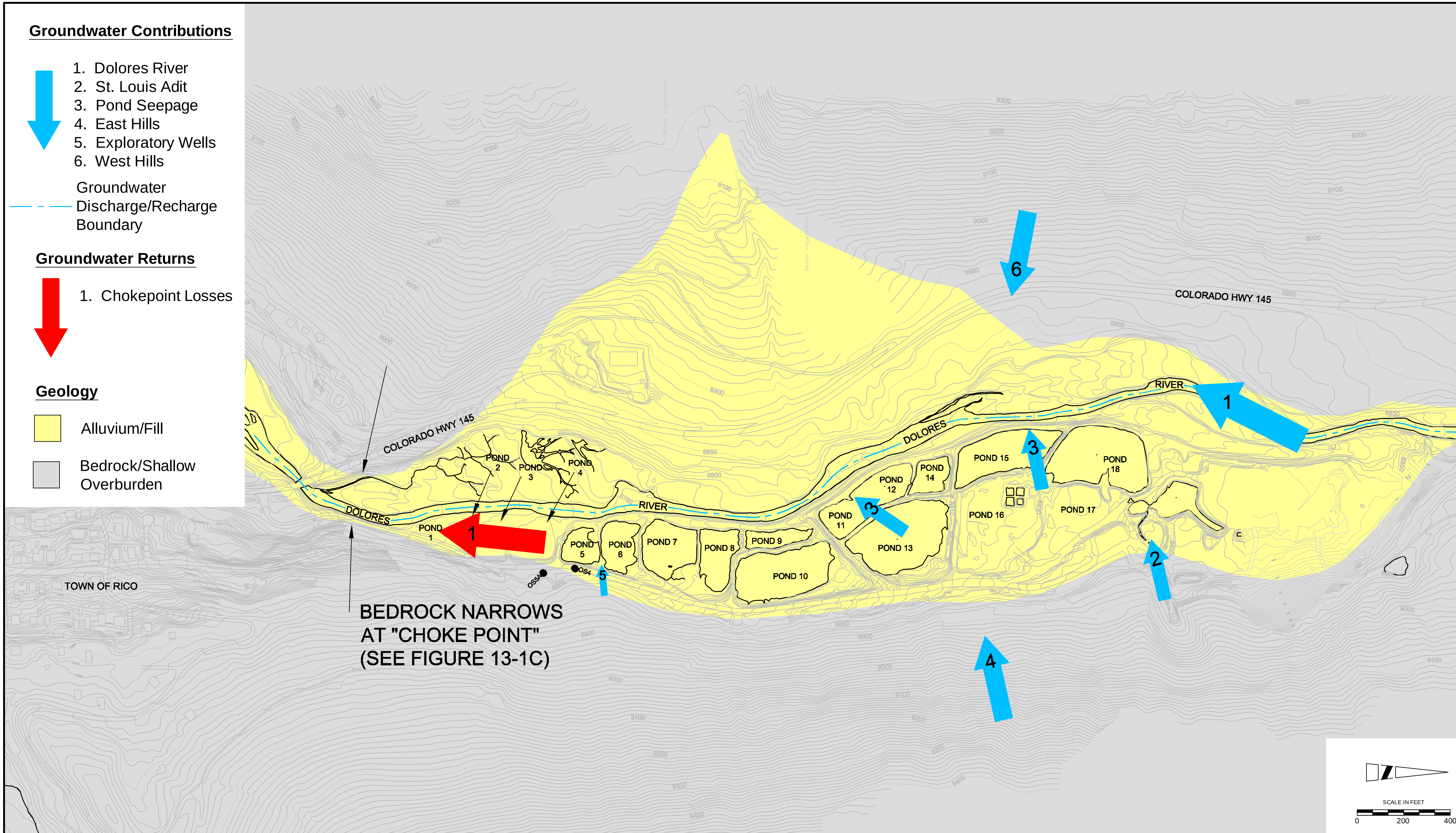
FIGURE 13-1E



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GROUNDWATER FLOW MODEL

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FIGURE 13-2

Legend:

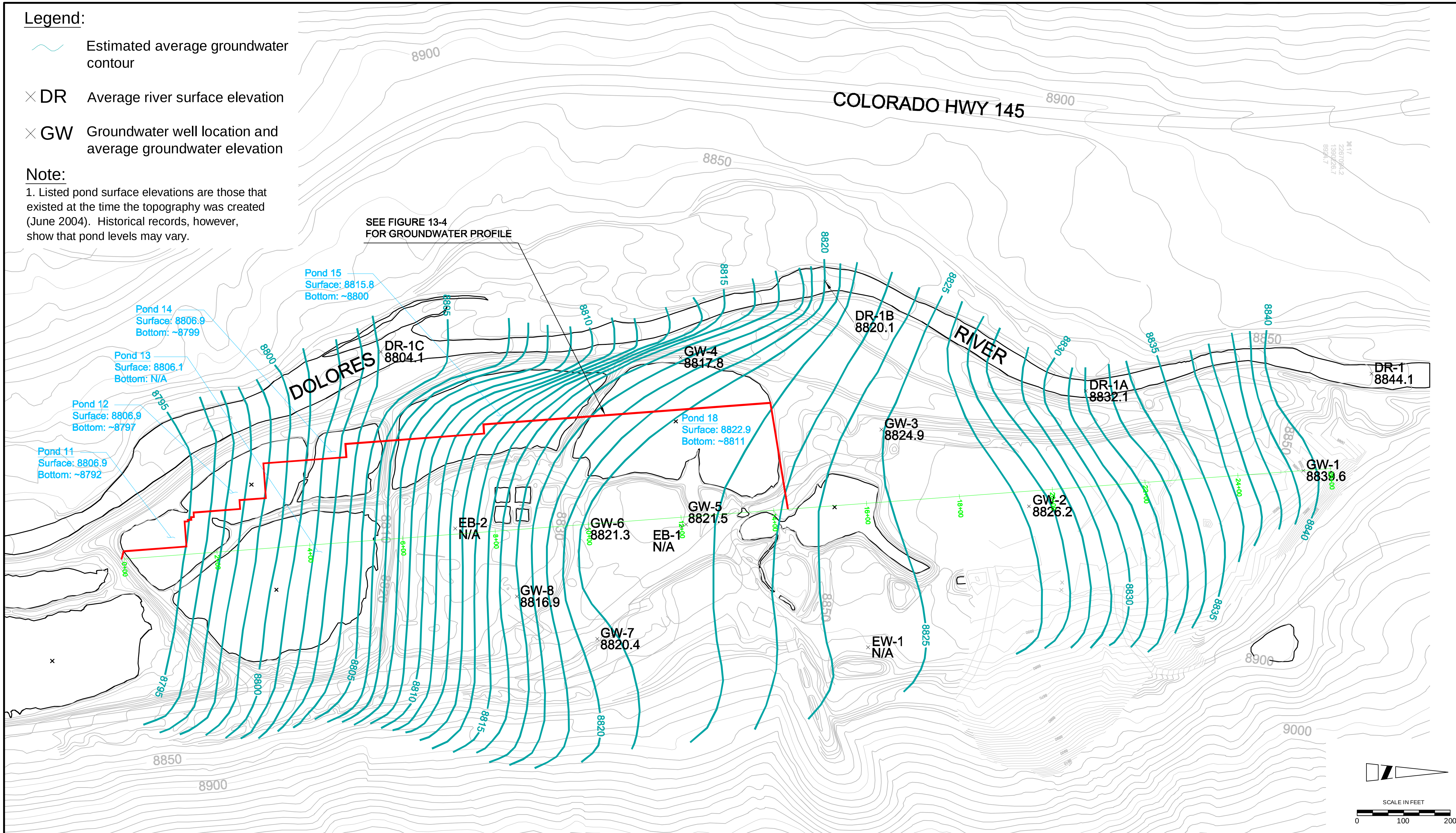
Estimated average groundwater contour

× DR Average river surface elevation

× GW Groundwater well location and average groundwater elevation

Note:

1. Listed pond surface elevations are those that existed at the time the topography was created (June 2004). Historical records, however, show that pond levels may vary.



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GROUNDWATER CONTOUR MAP

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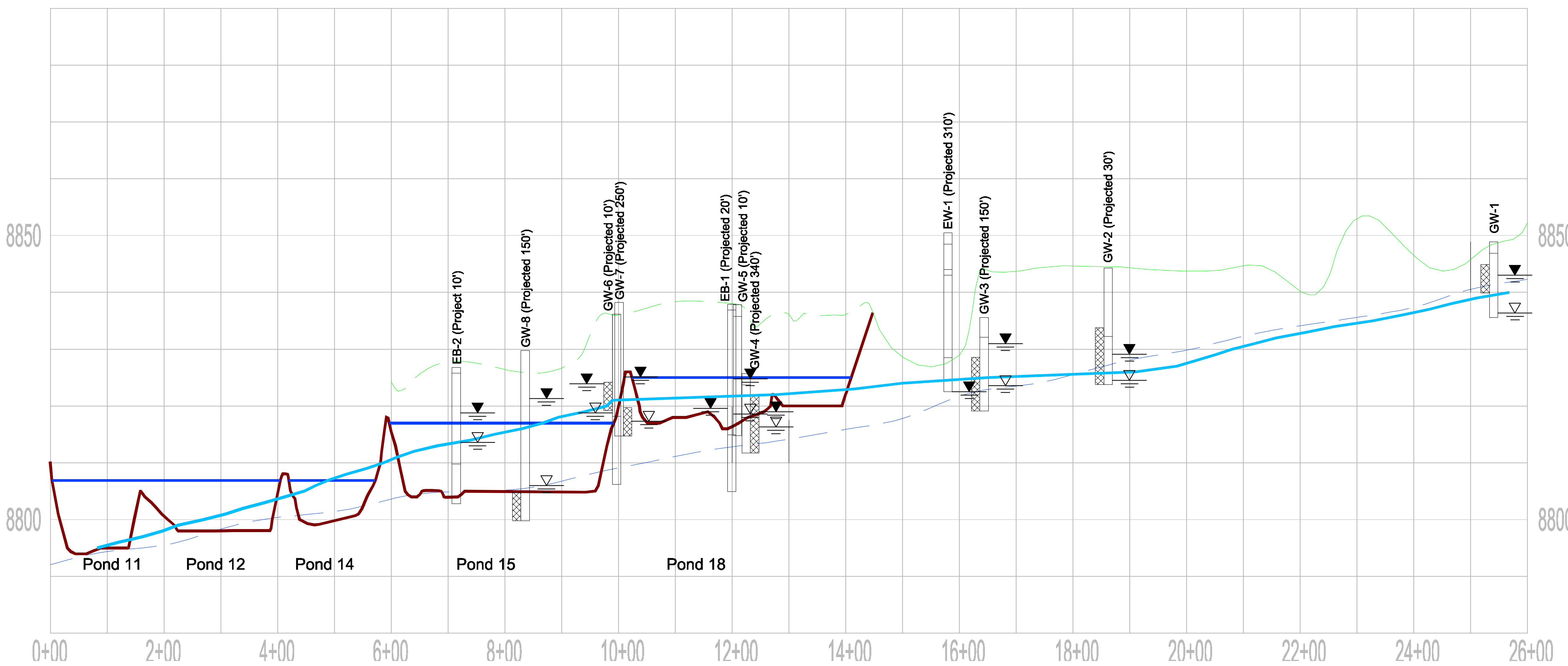
FIGURE 13-3



Vertical Scale Exageration - 10H:1V

SCALE IN FEET
0 100 200

Legend

Average Groundwater Level

Pond Water Surface

River Level (Projected)

Ground Surface Through Ponds

Existing Ground on Overbank

Groundwater Well with Screened Interval

Maximum Recorded Groundwater Elevation

Minimum Recorded Groundwater Elevation

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ST. LOUIS PONDS CDPS PERMIT APPLICATION		AECOM PROJECT NO.	FIGURE
GROUNDWATER PROFILE		60157757	13-4

Appendix A

Geologic/Geotechnical Data

-Well/Boring Logs

-Test Pit Logs

-Geotechnical Data

Well/Boring Logs

- Anderson Engineering/SEH, 2008
- SEH, 2004
- CDPHE, 2003
- Dames and Moore, 1981

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH-1	COORDINATES OR LOCATION:
LOGGED BY: K. Casper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 11' GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA. HOLE DIAMETER: FLUID USED: NA		DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Clayey silt with some sand and gravel; brown, moist	
2							
3							
4							
5							
6				50%			
7						Silty Sand & gravel dk. brown, moist	
8							
9							
10							
11		X	12 9 13	50%		Water - saturated	
12							
13						Cobbles	
14							
15							
16		X	13 33 27	60%		Saturated cobbles / boulders	
17							
18		X	50/1/2"	0		Refusal @ 17.5'	
19							

NOTES

TD= 17.5'

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: / PROJECT NO.: Rico Ponds	BORING NUMBER: DH-2	COORDINATES OR LOCATION:	
LOGGED BY: K. Cosper / CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 14	GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA	HOLE DIAMETER:	FLUID USED: NA	DATE STARTED: / DATE COMPLETED: 10/8/08
CASING TYPE AND SIZE:	FROM ____ A.G.S TO ____ B.G.S.		
SCREEN TYPE AND SIZE: NA	FROM ____ TO ____ B.G.S.		

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1							
2						Sandy silt, brown, moist	
3							
4						Clayey silt, minor sand and gravel, Red, moist	
5							
6		X	8 6 4	25%		Sandy silt with gravel, brown, moist	
7							
8							
9						Clayey silt with some gravel & cobbles, brown, moist	
10							
11		X	24 4 3	0			
12						Red wet silty sand - caliche -No Recovery-	
13		X	15				drilling on cobble
14			15 8	Wood		Brown clayey silt with gravel and cobbles, moist	
15		X	6	Wood			> wood in SS
16			15 14			Wood debris water @ 14	
17			50/3	50%		Sand & gravel, saturated w/ cobbles	
18		X	24 37 38	50%		Silt with some sand and wood debris, brown, saturated	
19						Sand and gravel, saturated w/ cobbles	
20						Drilling refusal @ 18.5	

TD= 18.5

NOTES

Try shelby at 5'. Hit rock, switched to SPT

Too many rocks

Drove SPT @ 12' - hit wood - Recovered ~ 1'. Smells like creosote

Try shelby at 14-16 - hit wood

Note - Cobbles throughout hole

BORING LOG

ANDERSON

PAGE 1 OF 1

PROJECT NAME: PROJECT NO.: Rico Ponds	BORING NUMBER: DH-3	COORDINATES OR LOCATION:
LOGGED BY: K. Cosper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: HSA	HOLE DIAMETER: / FLUID USED: NA	DATE STARTED: DATE COMPLETED: 10/9/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Red silty sand with gravel Calcite tailings	
2							
3							
4							
5		X	6				
6			4	10%			
7			4				
8							
9							
10							
11						No recovery, Shelby pushed 24" then free fell another 12".	
12							
13							
14						Drilled into void. Bottom of auger at 10'. Tape measured to 16'.	
15							
16							
17							
18						Used mirror to look into boring. Cavity opens to the south. Moving rig to another location ~ 30' to the west.	
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

NOTES

TD= 10'

Driller thought we hit the void at ~ 8'.

ANDERSON

BORING LOG

PAGE 1 OF 2

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH-3R		COORDINATES OR LOCATION: /
LOGGED BY: K. Cosper CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH (ENCOUNTERED) 24 GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA	HOLE DIAMETER:	FLUID USED: NA	DATE STARTED: 10/9/08 DATE COMPLETED:
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Silty sand and gravel,	
2						Brown,	
3							
4							
5							
6							
7							
8							
9							
10							
11							
12				75%		piece of mine waste Rock	
13						(oxidized) in tip of shelby.	
14						Sandy silt with clay	
15						Brown moist	
16			3 2 2	?		Oxidized (red/orange/yellow)	
17						Sand with some silt &	
18						fine gravel. Moist	
19							
20							
21							
22				60%			
23						Lt Brown? wet sandy silt.	
24						Water	
25							
26			10 10 10	50%		Saturated coarse sand, Gray	
27						Saturated Coarse sand and	
28						gravel; Gray/Brown	
29							
30							
31			10 10 13	50%			
32							

NOTES

TD= ________

20' Shelby - rock at bottom; Completely sealed end.

ANDERSON

BORING LOG

PAGE 2 OF 2

PROJECT NAME: PROJECT NO.:	BORING NUMBER: DW-3R	COORDINATES OR LOCATION: /
LOGGED BY: CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) GWL DEPTH (STATIC)

DRILLING METHOD:	HOLE DIAMETER:	FLUID USED:	DATE STARTED: DATE COMPLETED:

CASING TYPE AND SIZE: SCREEN TYPE AND SIZE:	FROM ______ A.G.S TO ______ B.G.S. FROM ______ TO ______ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
33							
34							
35							
36		X	17 17 14				
37							
38							

NOTES

TD= 35

BORING LOG

ANDERSON

PAGE 1 OF 1

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH-4	COORDINATES OR LOCATION:
LOGGED BY: K. Cosper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 11 GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA / HOLE DIAMETER: / FLUID USED: NA		DATE STARTED: / DATE COMPLETED: 10/7/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Silty sand + gravel	
2							
3						Red silty gravel - calcine ?	
4							
5						Silty sand w/ gravel	
6		X	8			Minor clay	
7			7 5				
8							
9						Black silt with clay	
10						Clayey gravel	
11		X	4 3		—	Water —	
12			2				
13						Silty gravel w/ clay	
14							
15							
16		X	0 4			saturated Gray / dk Brown	
17			8			Silty, clay	
18							
19						Saturated silt - Dk. Brown	
20						Flowing.	
		X	50/4"	30%		Silty sand and gravel dk. brown	

NOTES

TD= 20.5

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH-5	COORDINATES OR LOCATION:
LOGGED BY: K. Cosper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 11 GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA / HOLE DIAMETER: / FLUID USED: NA		DATE STARTED: / DATE COMPLETED: 10/7/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Silty sand + gravel	
2							
3						sandy gravel w/ silt	
4							
5							
6		X	4 10 6	25%		sandy silt with gravel.	
7							
8							
9							
10							
11		X	3 5 4	1%		Hit rock - no recovery	
12							
13							
14							
15							
16		I				Saturated Sandy SILT w/ some minor small gravel	
17							
18							
19							
20							
21		X	24/6 50/6			Silty Sand and gravel saturated	
22							
23						Cobbles - refusal @ 23'	
24							
25							

NOTES

TD= 23'

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH-6	COORDINATES OR LOCATION:
LOGGED BY: K. Cosper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 10 GWL DEPTH (STATIC) NA.
DRILLING METHOD: HSA	HOLE DIAMETER: / FLUID USED: NA	DATE STARTED: / DATE COMPLETED: 10/7/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Brown silty sand and Gravel	
2							
3						Sandy gravel	
4							
5							
6	California	X	30				
7							
8						Wet brown sandy silt & gravel	
9							
10						Saturated light Brown Sand & gravel	
11		X	15 7 7				water in hole
12							
13							
14							
15						Cobbles	
16				75%			
17							
18							
19							
20							
21				25%		tan saturated sand	
22							
23							
24							
25							

NOTES

TD= 25

Attempted Shelby @ 15'. Rock in auger. Shelby destroyed w/ no sample recovery. Pushed out plug w/ center punch. Attempting another shelby

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: PROJECT NO.: Rico Ponds	BORING NUMBER: DH-7	COORDINATES OR LOCATION:
LOGGED BY: R. Cospor CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 10 GWL DEPTH (STATIC) NA.
DRILLING METHOD: HSA	HOLE DIAMETER: / FLUID USED: NA	DATE STARTED: 10/9/08 DATE COMPLETED:
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA	FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Brown silty sand and gravel	
2							
3							
4							
5							
6		X	24 50/4"	25%		Wet brown silty sand and gravel	
7							
8							
9						Some clay present	
10							
11		X	35 19 44	60%		Saturated sand & gravel with some silt	Hard drilling - Cobbles
12							
13						Sandy silt with gravel & cobbles	
14							
15							
16							
17				100%		Silty sand with gravel	
18						?	
19							
20							
21		X	4 9 11	100%		Silt with fine sand saturated, lt brown	
22							
23							
24							
25							

NOTES

TD= 21.5

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Ponds PROJECT NO.:	BORING NUMBER: DH 8	COORDINATES OR LOCATION:
LOGGED BY: CHECKED BY: K. Cosper	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 6 GWL DEPTH (STATIC) NA.
DRILLING METHOD: HSA	HOLE DIAMETER: / FLUID USED: NA	DATE STARTED: 10/9/08 DATE COMPLETED:
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Silty Sand and Gravel, Brown	
2							
3							
4							
5							
6		X	9			water - saturated	
7			8 29				
8						Saturated brown sandy silt with gravel	
9							
10							
11		X	21				
12			30 20			Cobbles & Boulders	
13						Refusal @ 12'	

NOTES

TD= 12'

BORING LOG

ANDERSON

PAGE 1 OF 1

PROJECT NAME: RICO PONDS PROJECT NO.:	BORING NUMBER: DH-9	COORDINATES OR LOCATION:	
LOGGED BY: K. COSPER CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) ~ 17 GWL DEPTH (STATIC) NA	
DRILLING METHOD: HSA	HOLE DIAMETER:	FLUID USED: NA	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA	FROM ______ A.G.S TO ______ B.G.S. FROM ______ TO ______ B.G.S.		

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Red Calcine tailings Silty Sand	
2							
3							
4							
5							
6							
7							
8							
9							
10							
11		X	4 4 4	70%		Thin layer of gray saturated silt @ 11'	
12							
13							
14						Red silty sand Calcine Tailings	
15							
16							
17						Sand & Gravel - Saturated Black	
18							
19							
20							
21		X	12 24 30				
22							
23						Refusal @ 23.5'	
24							
25							
26							
27							
28							
29							
30							

NOTES

TD= 23.5'

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: PROJECT NO.: Rico Ponds	BORING NUMBER: DH-10	COORDINATES OR LOCATION:	
LOGGED BY: K Cosper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) ~13	GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA	HOLE DIAMETER:	FLUID USED: NA	DATE STARTED: DATE COMPLETED: 10/7/08

CASING TYPE AND SIZE: NA FROM ______ A.G.S TO ______ B.G.S.
SCREEN TYPE AND SIZE: NA FROM ______ TO ______ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Brown silty sand + gravel	
2							
3							
4							
5						Brown Clayey silt w/ minor gravel	
6							
7				<25%			
8							
9							
10							
11				35%			
12							
13							
14						Saturated dk brown-gray silt with minor gravel	
15			10 26 50/2	<25%			
16						Saturated brown sand + gravel some minor silt	
17							
18							
19						Rock encountered at 17'	
20						Refusal @ 17'	

NOTES

TD= 17'

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: / PROJECT NO.: Rico Ponds	BORING NUMBER: DH-11	COORDINATES OR LOCATION:
LOGGED BY: K. Cooper / CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) ~20 / GWL DEPTH (STATIC) NA
DRILLING METHOD: HSA / HOLE DIAMETER: / FLUID USED: NA		DATE STARTED: 10/8/08 / DATE COMPLETED: 10/8/08
CASING TYPE AND SIZE: / SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. / FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Brown Clayey silt, moist minor gravel	
2							
3							
4							
5						Red silty sand. Calcine tailings	
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17						Red Silt - calcine tailings	
18							
19							
20							
21			27			Sand + gravel, saturated red/brown w/ Cobbles	
22			50/1"			Refusal @ 21'	

TD= 21

NOTES

Attempted Shelby @ 10' but sample pulled out - 0 Recovery

BORING LOG

ANDERSON

PAGE 1 OF 2

PROJECT NAME: PROJECT NO.: Rico Ponds	BORING NUMBER: DH-12R	COORDINATES OR LOCATION:	
LOGGED BY: K. Casper CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 43'	GWL DEPTH (STATIC) NA
DRILLING METHOD: ODEX	HOLE DIAMETER:	FLUID USED: AIR	DATE STARTED: / DATE COMPLETED: 10/13/08

CASING TYPE AND SIZE: FROM ______ A.G.S TO ______ B.G.S.
SCREEN TYPE AND SIZE: NA FROM ______ TO ______ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1–4						Brown Sandy Silt with some clay and ~~gravel~~	
5–8						Brown Clayey Silt with some sand and small gravel	
9–10						Rock	
11–12						Red silty sand with gravel Calcine	
13–22		X	4 5 5			Brown Sandy Silt with some clay and gravel	
23–32						Brown Sandy Silt with Gravel	

NOTES

TD= ______

BORING LOG

ANDERSON

PAGE 2 OF 2

PROJECT NAME: PROJECT NO.:	BORING NUMBER: DH-12R	COORDINATES OR LOCATION:
LOGGED BY: CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 43 GWL DEPTH (STATIC) NA
DRILLING METHOD: ODEX	HOLE DIAMETER: / FLUID USED: AIR	DATE STARTED: DATE COMPLETED:
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
33							
34							
35						Sandy silt and gravel, minor clay	
36							
37							
38						Rock - ~~[illegible]~~	
39							
40						Sandy silt and gravel minor clay	
41							
42						Red rock with some silt & sand	
43							
44						gravel with some silt	Water @ 43'
45							
46							
47						Silty gravel	
48						Clayey silt w/ minor gravel moist - wet	out of water @ 48'
49							
50							
51						Sandy gravel with some silt, moist	
52							
53							
54						harder drilling	
55							
						TD ↑	

TD= 55'

NOTES

Some gravel is crushed rock from ODEX hammer bit. Unknown original size.

BORING LOG

ANDERSON

PROJECT NAME: PROJECT NO.: Rico Ponds	BORING NUMBER: DH-13	COORDINATES OR LOCATION:
LOGGED BY: CHECKED BY: K. Cosper	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 8' GWL DEPTH (STATIC) NA
DRILLING METHOD: ODEX / HOLE DIAMETER: / FLUID USED: AIR		DATE STARTED: DATE COMPLETED: 10/13/08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA	FROM ______ A.G.S TO ______ B.G.S. FROM ______ TO ______ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
1						Brown silt & sand with some gravel	
2							
3							
4							
5							
6						wood debris	
7							
8						silty sand and gravel moist, brown	
9							
10							
11							water @ 8'
12							
13							
14						saturated silty sand and gravel brown	
15							
16							
17						saturated lt brown silty gravel	
18							
19						saturated lt brown silty sand	
20							
21							
22							
23							
24							
25						grades more silty	
26							
27							
28							
29							
30							

NOTES

TD= ________

ANDERSON

BORING LOG

PROJECT NAME: / PROJECT NO.: Rico Ponds	BORING NUMBER: DH-13	COORDINATES OR LOCATION:
LOGGED BY: K. Casper / CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH (ENCOUNTERED) 8' / GWL DEPTH (STATIC) NA
DRILLING METHOD: ODEX / HOLE DIAMETER: / FLUID USED: AIR		DATE STARTED: / DATE COMPLETED: 10/13/08
CASING TYPE AND SIZE: / SCREEN TYPE AND SIZE:		FROM ____ A.G.S TO ____ B.G.S. / FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45						Less silty	
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
						TD	

NOTES

TD= 55

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EW-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/20/2004	11/21/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EW-1	Feet Site	8,850.5 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location: 1389193 Feet ☒ N ☐ S; 2268176 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	17-20 15-11		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					35					Note: Compressive Strength = SPT N value. Note: Length att. on split spoon = 24"
2 SS	24	5-7 7-7	2	Brown, medium dense, fine to coarse grained CLAYEY SAND, with gravel.	SC				14					
3 SS	24	5-11 5-2	4–6						16					
4 SS	24	4-4 6-3	8	Brown, loose, fine to coarse grained, CLAYEY SAND.	SC				10					
5 SS	24	2-8 4-5	10	Brown, loose to very dense, fine to coarse grained, CLAYEY SAND and gravel					12					
1 SH	6		12											
6 SS	24	5-4 2-4	14		SC				6					approx. 6 inches recovery
2 SH	24		16											
7 SS	24	6-8 10-8	18						18					
			20											
8 SS	24	50	22–24	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP				50					

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm		
Daniel R. Reed	SEH Inc	421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com	Tel: 715.720.6200 Fax: 715.720.6300

Boring Number EW-1 Use only as an attachment to Form 4400-122.

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			26	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP									
			28	End of boring at 28' (refusal)										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EW-2A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/21/2004	11/21/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,846.4 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location: 1389198 Feet ☒ N ☐ S; 2268004 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	1-3 12-9		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					15					Note: Compressive Strength = SPT N value. Note: Length att. on split spoon = 24"
			2	Brown, loose, fine to coarse grained CLAYEY SAND, with gravel.	SC									
2 SS	24	3-7 4-5	4						11					
3 SS	24		6	Brown, loose, SANDY CLAY to clayey sand, with gravel.	CL									
4 SS	24	3-4 3-3	8	Brown, medium stiff, SANDY CLAY, with gravel	CL-ML				7					
5 SS	24	5-8 8-17	10	Brown, stiff, SANDY CLAY to clayey sand, with gravel	CL-ML				16					
			12	End of boring at 12' (abandoned)										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm: SEH Inc, 421 Frenette Drive, Chippewa Falls, WI 54729, www.sehinc.com — Tel: 715.720.6200, Fax: 715.720.6300

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number	
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-1	
Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/15/2004	11/18/2004	hsa/odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EB-1	8,820.9 Feet Site	8,837.9 Feet Site	8.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location: 1388792 Feet ☒ N ☐ S; 2267917 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	29-44 18-14		FILL: Gray, very dense, WASTE ROCK, igneous cobbles					62					Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24"
2 SS	24	5-8 8-12	2	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel					16					
3 SS	24	4-9 8-11	4						17					
4 SS	24	5-5 7-7	6						12					
1 SH	24		8											
2 SH	24		10											
4 SS	24	5-4 4-3	12		SM				8					
3 SH	24		14											
5 SS	24	2-2 6-16	16				▼		8					
4 SH	24		18											
6 SS	24	12-7 9-7	20						16					
5 SH	24		22											
			24		GP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
Daniel R. Reed	SEH Inc 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com	Tel: 715.720.6200 Fax: 715.720.6300

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EB-1 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			26	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.										
7 SS	24	22-20 24-50	28		GP				44					
			30											
			32											
				End of boring at 33' (refusal)										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: St. Louis Ponds Area, Rico, Colorado			License/Permit/Monitoring Number: AARCOE0105.00		Boring Number: EB-2	
Boring Drilled By: Name of crew chief (first, last) and Firm: Jeff Pennell, Layne-Western			Date Drilling Started: 11/19/2004	Date Drilling Completed: 11/19/2004		Drilling Method: hollow stem auger
WI Unique Well No.	DNR Well ID No.	Common Well Name: EB-2	Final Static Water Level: 8,818.8 Feet Site	Surface Elevation: 8,826.8 Feet Site		Borehole Diameter: 8.0 inches
Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐ State Plane N, E S/C/N NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W			Lat ° ' " Long ° ' "	Local Grid Location ☐ N Feet ☐ S		☐ E Feet ☐ W
Facility ID	County		County Code	Civil Town/City/ or Village: Rico, Colorado		

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
1 SS	24	4-6 4-7	2	FILL("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel	SM				10					Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24"
2 SS	24	4-4 5-4	4						9					
3 SS	24	3-3 6-3	6						9					
4 SS	24	3-2 1-1	8						3					
			10											
			12											
5 SS	24	1-1 1-1	14						2					
			16											
			18	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									
6 SS	24	12-24 50	20						74					
			22											
			24	End of boring at 24'										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm: **SEH Inc** 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com
Tel: 715.720.6200
Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-2D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/18/2004	11/19/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,826.0 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location
1388306 Feet ☒ N ☐ S 2267920 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0	FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
			1	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel	SM									
1 SH	24		3											Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24" 3" diameter split spoon used (no shelby rec)
2 SH	24		5											
1 SS	24		7											
3 SH	24		9											
4 SH	24		11											
2 SS	24	4-1 1-4	15						2					
			18	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm: **SEH Inc** 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EB-2D Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				End of boring at 24' (abandoned - moved to EB-2, approx. 10' to east)										

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW1	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 9 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	9 ft.	Depth to Water Before Development (L^t):	6.5 ft.
Height of Water Column (L^w - L^t):	6 ft.		
Depth to Top of Sediment (L^j)	9 ft.	Sediment Thickness (L^w - L^j):	Na ft.
Well Volume:	0.96 gal.		
Total Volume Pumped:	30 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	30+ volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW1

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.2	7.37	359	27	Slightly turbid
10/16/02	10.8	7.36	359	29	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1345 — Sample Collected

Lithology

0-9 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

CDPHE
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW2	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 10.5 ft. To 20.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	20.5 ft.	Depth to Water Before Development (L^t):	6.5 ft.
Height of Water Column (L^w - L^t):	2.0 ft.		
Depth to Top of Sediment (L^l)	20.5 ft.	Sediment Thickness (L^w - L^l):	Na ft.
Well Volume:	0.32 gal.		
Total Volume Pumped:	5 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	4x volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW2

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.9	7.29	1004	Purged dry four times	Clear
				Total of 5 gallons max	

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1620	Sample Collected

Lithology

0-12 feet	Spent pyretic ore with mixed coble and rock. Ore materials are green and purple in color. Leach pad liner at 12 feet bgs
12-20.5 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW3	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 7 ft. To 16.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	16.5 ft.	Depth to Water Before Development (L^t):	6.5 ft.
Height of Water Column (L^w - L^t):	9.5 ft.		
Depth to Top of Sediment (L^t)	16.5 ft.	Sediment Thickness (L^w - L^t):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	15 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	14 volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW3

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.6	6.46	1526	5	Slightly turbid
10/16/02	10.9	6.45	1529	7	Slightly turbid
10/16/02	10.6	6.44	1484	8	Slightly turbid
10/16/02	10.8	6.42	1512	9	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1100 — Sample Collected

Lithology

0-3.5 feet	Spent pyretic ore with mixed coble and rock.
3.5-16.5 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
enver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW4	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 14 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	14 ft.	Depth to Water Before Development (L^t):	7 ft.
Height of Water Column (L^w - L^t):	7 ft.		
Depth to Top of Sediment (L^i)	14ft.	Sediment Thickness (L^w - L^i):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	27 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	25+ volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW4

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	14.0	7.20	1385	24	Slightly turbid
10/16/02	13.5	7.20	1380	25	Slightly turbid
	13.7	7.20	1383	27	Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1600 — Sample Collected

Lithology

0-2 feet bgs	Gravel fill material
2-14 feet bgs	Rip rap materials and cobble

Presented By	Date	Checked By	Date

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW5	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 18 ft. to 23 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	23 ft.	Depth to Water Before Development (L^t):	15 ft.
Height of Water Column (L^w - L^t):	8 ft.		
Depth to Top of Sediment (L^f)	14ft.	Sediment Thickness (L^w - L^f):	Na ft.
Well Volume:	1.28 gal.		
Total Volume Pumped:	46 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	46 gallons purged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW5

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.8	6.89	2620	45	Slightly turbid
10/17/02	13.4	6.90	2620	45.5	Clear, Slightly turbid
	13.7	6.91	2610	46	Clear

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1145 — Sample Collected

Lithology

0-2 feet bgs	Waste rock materials
2-23 feet bgs	Purple roasted tailings, wet

Presented By	Date	Checked By	Date

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW6	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 12 ft. to 17 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	30 ft.	Depth to Water Before Development (L^t):	25 ft.
Height of Water Column (L^w - L^t):	5 ft.		
Depth to Top of Sediment (L^i)	30ft.	Sediment Thickness (L^w - L^i):	Na ft.
Well Volume:	0.8 gal.		
Total Volume Pumped:	8 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	8+ volumespurged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW6

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.1	6.49	4000	6	Slightly turbid
10/17/02	12.6	6.38	3970	7	Clear, Slightly turbid
10/17/02	13.1	6.42	4110	8	Clear
			* Purged dry total of 8 times, Collected sample on 9th recharge		

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1645	Sample Collected

Lithology

0-18 feet bgs	Purple roasted tailings mixed with waste rock and river cobble
18-30 feet bgs	Native Rock, Cobble

Presented By	Date	Checked By	Date

CDPHE

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW7	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 19 ft. to 24 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	24 ft.	Depth to Water Before Development (L^t):	19 ft.
Height of Water Column ($L^w - L^t$):	5 ft.		
Depth to Top of Sediment (L^t)	24 ft.	Sediment Thickness ($L^w - L^t$):	Na ft.
Well Volume:	0.8 gal.		
Total Volume Pumped:	35 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	43+ volumes purged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW7

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	15.5	6.51	1679	26	Slightly turbid
10/17/02	15.7	6.51	1719	35	Clear

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1550 — Sample Collected

Lithology

0-24 feet bgs	Waste rock / river cobble

Presented By	Date	Checked By	Date

CDPHE
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park

Project Name: Rico Light Industrial Park

Well Number: RLP-GW8

Well Location: Rico Light Industrial Park

Time / Date: 10/17/02

Elevation : 8,800 msl

Drilling Method: 4-Inch Hollow Stem Auger

Weather: Clear Skies, Partly Sunny 60°F Slight Breeze

Development Company: Kayenta Consulting

Date Development Started: 10/17/02

Date Development Completed: 10/17/02

Screen Intervals: 25 ft. to 30 ft bgs

Well Diameter: 2 Inch

Depth of Well (L^w): 30 ft.

Depth to Water Before Development (L^t): 25 ft.

Height of Water Column (L^w - L^t): 5 ft.

Depth to Top of Sediment (L^i) 30 ft.

Sediment Thickness (L^w - L^i): Na ft.

Well Volume: 0.8 gal.

Total Volume Pumped: 24 gal.

Number of Well Volumes Pumped (total volume pumped/well volume): 24+ volumes purged on 10/17/02

0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW8

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.0	6.46	2510	22	Clear, Slightly turbid
10/17/02	12.9	6.58	2520	23	Clear, Slightly turbid
10/17/02	12.5	6.64	2520	24	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1735 Sample Collected

Lithology

0-1 feet bgs	Fill material
1-24 feet bgs	Red purple slimes, roasted tailings, saturated
24 – 30 feet bgs	Native materials, river cobble

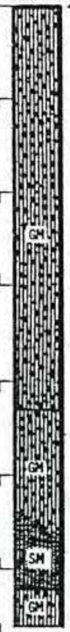
Presented By	Date	Checked By	Date

BORING B-1

SURFACE ELEVATION 8833
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										18	SPT	5
										9	SPT	10
										7	SPT	15
				14						13	SPT	20
										28	D	25
										21	SPT	30
										50/5"	SPT	33
												35
												40
												45
												50
												55
												60
												65
												70

SYMBOLS



DESCRIPTION

BROWN FINE TO COARSE SANDY GRAVEL WITH SILT MEDIUM DENSE

GRADES WITH LENSES OF SILTY SAND AND SANDY SILT

COLORS GREY AND GRADES WITH SOME CLAY
GRADES LOOSE TO MEDIUM DENSE

GRADES LOOSE

GRADES WITH MORE GRAVEL AND MEDIUM DENSE

FILL (0 to approx. 21.8 feet)

DARK BROWN TO BLACK SILTY GRAVEL WITH SAND, MEDIUM DENSE

BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL MEDIUM DENSE

BROWN SANDY GRAVEL, DENSE TO VERY DENSE
AUGER REFUSAL AT 33 FEET
BORING COMPLETED AT 33.5 FEET ON 6/3/81
WATER ENCOUNTERED AT 21.8 FEET ON 6/3/8/

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:

1. THE SOIL CONDITIONS ARE DESCRIBED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, PLATE A-3.
2. BLOW COUNT HAS BEEN TAKEN AS THE NUMBER OF BLOWS REQUIRED TO DRIVE A SAMPLER TO ONE-FOOT PENETRATION USING A 140 POUND WEIGHT FALLING 30 INCHES.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 04010-082-1408

BORING B-2

SURFACE ELEVATION 8834
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										26	SPT	5
GRADATION				22			32	17	15	8	SPT	10
										12	SPT	15
										21	SPT	20
						67	67	51	16	5	SPT	25
						66				11	SPT	25
										50 for 1/4"	SPT	30
												35
												40
												45
												50
												55
												60
												65
												70

SYMBOLS	DESCRIPTION
SC	BROWN CLAYEY SAND WITH GRAVEL MEDIUM DENSE
SM	BROWN AND GREY GRAVELLY SAND WITH SOME CLAY
SC	YELLOW AND BROWN FINE TO COARSE CLAYEY SAND WITH GRAVEL LOOSE LUMBER FRAGMENTS AT 15 FEET GRADES MEDIUM DENSE
GM	GREY & BROWN SANDY GRAVEL WITH SOME SILT MEDIUM DENSE
MH	DARK BROWN AND BLACK FINE SANDY SILT SOFT TO MEDIUM STIFF

FILL (0 to about 23 feet)

AUGER REFUSAL AT 30.5 FEET
BORING COMPLETED AT 30.5 FEET ON 6/4/81
WATER ENCOUNTERED AT 20.7 FEET ON 6/3/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

PLATE A-1B

FILE ANACONDA RICO 04010-082-160B

BORING B-3

SURFACE ELEVATION 8836
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	STRENGTH TEST RESULTS: CONFINING PRESSURE (psf)	STRENGTH TEST RESULTS: PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	ATTERBERG LIMITS: PL (%)	ATTERBERG LIMITS: PI (%)	SAMPLING: BLOW COUNT	SAMPLING: SAMPLE TYPE	DEPTH IN FEET
												0
				42						6	SPT	5
										32	SPT	10
										7	SPT	15
										23	SPT	20
												25
												30

SYMBOLS DESCRIPTION

GC — FILL (0 to 20 feet)

- 0: BROWN SANDY CLAYEY GRAVEL WITH SAND. LOOSE
- 5: SAMPLER DRIVEN THROUGH COBBLE
- 10: GRADES MEDIUM DENSE
- 20: AUGER REFUSAL AT 20'
  BORING COMPLETED AT 20 FEET ON 6/5/81
  NO WATER ENCOUNTERED

BORING B-4

SURFACE ELEVATION 8835
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	STRENGTH TEST RESULTS: CONFINING PRESSURE (psf)	STRENGTH TEST RESULTS: PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	ATTERBERG LIMITS: PL (%)	ATTERBERG LIMITS: PI (%)	SAMPLING: BLOW COUNT	SAMPLING: SAMPLE TYPE	DEPTH IN FEET
												0
										8	SPT	5
GRADATION				22		15	27	21	6	5	SPT	10
												15
										1	SPT	20
												25
												30

SYMBOLS DESCRIPTION

SC-GC — FILL (0 to 20 feet)

- 0: BROWN CLAYEY SAND AND GRAVEL WITH COBBLES LOOSE
- 20: CL — DARK BROWN SILTY AND SANDY CLAY WITH ORGANIC MATERIAL
- AUGER REFUSAL AT 24.5 FEET
  BORING COMPLETED AT 24.5 FEET ON 6/5/81
  NO WATER ENCOUNTERED

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ☒ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

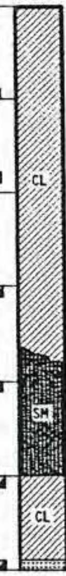
PLATE A-1C

FILE ANACONDA RICO 04010-082-1605

BORING B-5

SURFACE ELEVATION 8839
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
pH, SULFATES						5	31	20	11	11	SPT	5
										11	SPT	10
										32	SPT	15
				43						11	SPT	20
						13	44	23	21	38	SPT	25
										50 for 4 1/2"	SPT	30



SYMBOLS DESCRIPTION

BROWN SANDY CLAY WITH SOME GRAVEL STIFF

GRADES WITH MORE GRAVEL

YELLOW-BROWN GRAVELLY SAND WITH SOME CLAY AND WOOD FRAGMENTS LOOSE TO MEDIUM DENSE

FILL (0 to 25 feet)

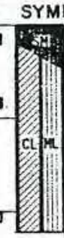
DARK BROWN SANDY CLAY

AUGER REFUSAL AT 29.5 FEET
WEATHERED SANDSTONE BEDROCK
BORING COMPLETED AT 30.25 FEET ON 6/6/81
WATER ENCOUNTERED AT 25.5 FEET ON 6/6/81

BORING B-6

SURFACE ELEVATION 8793
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
										2/4"	SPT	0
				25			28	19	7	5	SPT	5
										50/0"	SPT	10



SYMBOLS DESCRIPTION

DARK BROWN SILTY SAND WITH GRAVEL AND COBBLES MEDIUM DENSE

DARK BROWN CLAYEY SILT AND SILTY CLAY WITH GRAVEL AND COBBLES MEDIUM STIFF

AUGER REFUSAL AT 10 FEET
BORING COMPLETED AT 11 FEET ON 6/7/81
WATER ENCOUNTERED AT 5 FEET ON 6/7/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

PLATE A-1D

FILE ANACONDA RICO 04010-082-1605

BORING B-7

SURFACE ELEVATION 8808
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SYMBOLS	DESCRIPTION
												0	GM	BROWN AND GREY SANDY GRAVEL WITH SOME SILT LOOSE
										7	SPT	5		
										9	SPT	10	SC	BROWN CLAYEY SAND WITH GRAVEL LOOSE TO MEDIUM DENSE
										33	SPT	15	GM	BROWN SANDY GRAVEL WITH SILT MEDIUM DENSE TO DENSE
												20		AUGER REFUSAL AT 17.5 FEET BORING COMPLETED AT 17.5 FEET ON 6/7/81 WATER LEVEL ENCOUNTERED AT 15 FEET
												25		
												30		

BORING B-8

SURFACE ELEVATION 8814
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SYMBOLS	DESCRIPTION
												0	SM	BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL LOOSE TO MEDIUM DENSE
										2	SPT	5	ML	DARK BROWN CLAYEY SILT WITH SAND
													GM	BROWN SANDY FINE GRAVEL WITH CLAY
GRADATION				10						25/6"	SPT	10		AUGER REFUSAL AT 12 FEET BORING COMPLETED AT 12 FEET ON 6/7/81 WATER LEVEL ENCOUNTERED AT 9 FEET ON 6/7/81
												15		
												20		
												25		
												30		

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

Added 2/19/07

LOG OF BORING

DAMES & MOORE

Test Pit Logs

- Anderson Engineering / SEH, 2008
- SEH, 2004
- SEH, 2001
- Anderson Engineering, 1996

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, CO PROJECT NO.: ST LOUIS POND	BORING NUMBER: TP-1	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 7.8 (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Gravel on surface w/ road base course	
1.0		X				Dark brown silty sand with	
1.5	①	X				gravel	
2.0	2-1	X					
2.5		X					
3.0	②	X				Red tailings (calcine) with gravel and rock (2"-8")	
3.5	3.4	X				approx 20-25% rock	
4.0		X				Dark brown clay silt	
4.5		X				with gravel and rock	
5.0		X				(2"-12") ~10-12% rock	
5.5	③	X					
6.0		X				moist	
6.5		X					
7.0		X					
7.5		X					
8.0	7.8	X				caving at 7.0' due to rock fall	water encountered at 7.8'

NOTES

TD= 7.8'

Pit Backfilled & Compacted

X = Sample Collected, Composit of Material

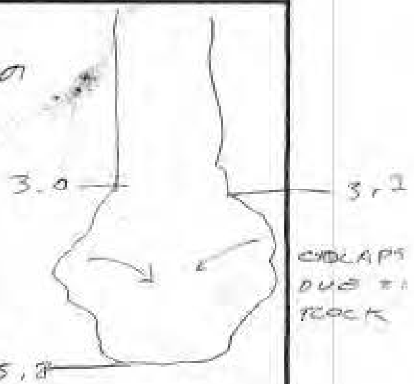
BORING LOG

ANDERSON

PAGE 1 OF 1

PROJECT NAME: Rico Co PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-2	COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH No water ~~(ENCOUNTERED)~~ GWL DEPTH (STATIC)
DRILLING METHOD: Backhoe Test Pit · HOLE DIAMETER: NA · FLUID USED: NA		DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5		X				Gravel on surface	
1.0	①	X				Dark Brown, silty sand with minor	
1.5		X				gravel	
2.0	2.2	X					
2.5		X				Brown sandy silt soil with	
3.0		X				gravel and rock (2" to 14" Ø)	
3.5	②	X				moist, Rock ~10 to 12%	
4.0		X					
4.5		X					
5.0		X					
5.5		X				Trench cave in on side walls	
6.0	5.8	X					



No water encountered

NOTES

TD= 6.0

Did not continue due to cave in of side wall in trench

X = Sample, Backfilled & Compacted

ANDERSON

BORING LOG

PROJECT NAME: RICO CO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-3	COORDINATES OR LOCATION:
LOGGED BY: CL CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH No water encountered (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH, (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5		X				Surface gravel 3/4"	
1.0		X				Sandy silt, dark brown soil,	
1.5		X				minor amounts of gravel	
2.0	1.8					Silty sand, redish brown, mixed soil & tailings (calcine)	
2.5		X					
3.0	2.8					Sandy silt, brown with	
3.5		X				gravel, moist, some large	
4.0		X				rock (6" - 12"ø) moist	
4.5		X					
5.0		X					
5.5		X					
6.0		X					
6.5		X					
7.0		X					
7.5		X					
8.0	7.8						

Sample 1 (0.5–2.0)
Sample 2 (2.0–3.0)
Sample 3 (3.0–8.0)

NOTES

TD= 7.8' No Water

TEST PIT BACKFILLED, COMPACTED

X = SAMPLE COLLECTED, COMPOSIT OF INTERVAL

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico CO PROJECT NO.: St Louis Pond	BORING NUMBER: TP-4	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 7.8' (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Gravel on surface	
1.0	0.7	X				Silty sand, Dark brown dry	minor amounts of tails
1.5	1.5					Sandy silt with minor gravel Light brown	
2.0		X				Clay Silt with minor sand	
2.5						Brown soil w/ gravel	
3.0						moist	
3.5							
4.0							
4.5	4.5'						
5.0		X				clay silt, with minor sand	
5.5						with gravel, Dark brown	
6.0						some tailings mixed in	
6.5						soil moist at top	
7.0							
7.5						wet at 7.5	
8.0	7.8'						7.8' WATER ENCOUNTER

NOTES

TD= 7.8'

- Water
- Backfilled & compacted

X = Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, Co PROJECT NO.: ST Louis Ponds	BORING NUMBER: TP-5		COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: NA	FLUID USED: NA	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5	0.3					Gravel on surface, Dark brown soil cap - sandy silt	
1.0	1.1 ①					yellow brown tailings & mine waste with gravel and rock (2" - 6" Ø) 70% rock	
1.5						Brown soil mixed with red calcine tailings, silty sand containing gravel and rock (2" to 12"Ø) ~ 20-30% rock	
2.0							
2.5	②						
3.0							
3.5	3.6						
4.0						Brown soil, silty sand mixed with calcine tailings, minor gravel and some rock (2"-6") ~5% rock	
4.5							
5.0							
5.5							
6.0	③						
6.5							
7.0							
7.5							
8.0	7.9						NO WATER ENCOUNTERED

NOTES

TD= 7.9'

1) Test Pit Backfilled + Compacted

X - Sample Collected + Composit of Material

Foundation

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Project PROJECT NO.: St Louis Ponds	BORING NUMBER: TP-6		COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH No water encountered (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT	FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.	

	DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
Sample 1	0.5						Gravel on surface	
	1.0	①					Dark grey soil with waste rock, gray in color (1" to 6") soil sandy, with gravel	
	1.5							
	2.0	2'						
Sample 2	2.5						Redish sandy tailings with gravel	
	3.0	②						
	3.5							
	4.0	3.8						3.8
Sample 3	4.5						Cream colored sandy tailings with	
	5.0						gravel and rock (2" to 12")	
	5.5	③					Pyrite material mixed in this zone	
	6.0						NOTE: This layer was colapsing and under	
	6.5						cutting when excavated	
	7.0	7.3						7.3
	7.5							
	8.0							

NOTES

TD= 7.3'

No Water
Pit Backfilled and compacted
X - Sample Collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, CO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-7		COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH NO WATER (ENCOUNTERED) GWL DEPTH ENCOUNTERED (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: NA	FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

	DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
SAMPLE 1	0.5						TOP SURFACE GRAVEL	
	1.0						BROWN SOIL - SILTY SAND	
	1.5	1					WITH GRAVEL	
	2.0							
SAMPLE 2	2.5	2.4						
	3.0	2					BROWN SOIL / TAILINGS	
	3.5						SANDY SOIL w/ SOME SILT MIXED WITH RED TAILINGS (CALCINE)	
SAMPLE 3	4.0	3					TAILINGS, LIGHT BROWN TO CREAM IN COLOR, RED OXIDATION STAIN ON ROCK	
	4.5						BROW SOIL, SILTY SAND WITH GRAVEL,	
SAMPLE 4	5.0							
	5.5						LARGE ROCK ENCOUNTERED (12"-18")	
	6.0						w/ BROWN SOIL, SILTY SAND W/GRAVEL	
	6.5	4					CONTAINS MINOR AMOUNT OF TAILINGS	
	7.0							
	7.5							
	8.0	7.7						

NOTES

TD= 7.7'

No Water Encountered
Pit Backfilled & Compacted
X = Sample Collected Composite of Material

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico CO PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-8		COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH ∅ No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: Backhoe / Test Pit	HOLE DIAMETER: NA	FLUID USED: NA	DATE STARTED: 10-14-08 DATE COMPLETED: 10-14-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Brown sandy silt with gravel and cobbles, moist ~5% Rock	
1.0							
1.5						minor lenses of calcine tailings	
2.0							
2.5						Gray/white sandy gravel, several Boulders (≥12" ∅ at this layer) Hard, stiff 60% Rock	
3.0						Brown sandy silt with gravel and cobbles, moist ~5% rock	
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							

NOTES

TD= 6.0

1) Test Pit Backfilled & Compacted

X - Sample Collected, Composite of Material

ANDERSON

BORING LOG

PROJECT NAME: RICO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-9	COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 6.7' (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S

	DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
Sample 1	0.5	0	X				GRAVEL ON SURFACE - Brown soil, Silty sand with gravel and rock (2" to 14")	
	1.0							
	1.5							
	2.0							
	2.5	1						
	3.0							
	3.5							
	4.0							
	4.5	4.8'						
Sample 2	5.0		X				Brown soil with redish tailings Silty sand with gravel and rock (2" to 16") mixed with tailings, interspersed clumps of tailings	water encounter @ 6.7'
	5.5	2						
	6.0							
	6.5	6.7						
	7.0							

NOTES

TD= 6.7'

TEST PIT BACKFILLED, COMPACTED

X = SAMPLE COLLECTED, COMPOSIT OF INTERVAL

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: RICO PROJECT NO.: ST LOUIS POND	BORING NUMBER: TP-10	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 6.4' (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.

	DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
Sample 1	0.5	①	X				Gravel on surface Brown silty sand with gravel some small rock	
	1.0	1.2'						
Sample 2	1.5		X				Brown silty sand w/ gravel and rock (2" to 12")	
	2.0							
	2.5							
	3.0	3.2'						
	3.5	3.5					SOIL LAYER - BROWN silty sand no gravel	
	4.0	②					Brown silty sand with gravel and rock (2"-12")	
	4.5							
	5.0							
	5.5							
	6.0							WATER ENCOUNTERED 6.4'
	6.5	6.4						

NOTES

TD= 6.4'

PIT BACKFILLED & COMPACTED

X - SAMPLE Collected, Composit of material

ANDERSON

BORING LOG

PROJECT NAME: RICO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-11	COORDINATES OR LOCATION:
LOGGED BY: CS CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 4.2' (ENCOUNTERED) from surface GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5	① 0.5	X				light Brown sandy silt soil w/ 3/4" gravel	
1.0	② 1.0	X				light Brown sandy silt soil w/ some gravel	geotextile liner at 1.0'
1.5	③	X				Brown silty sand and gravel	
2.0						Some rock (2"–8") intermixed	
2.5	2.5					tails (cream to red) very moist	
3.0	3.0					Layer of tailings	
3.5	④	X				Brown clay sand silt with gravel	
4.0						and rock (2" to 12") intermixed	water at 4.2'
4.5						tails (light brown / cream to red)	
5.0	5.0						

NOTES

TD= 5.0'

PIT BACKFILLED & COMPACTED

X = SAMPLE Collected, Composit of Material

ANDERSON

BORING LOG

TEST PIT

PROJECT NAME: RICO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP12		COORDINATES OR LOCATION:
LOGGED BY: C.S. CHECKED BY:	SURFACE ELEVATION: NA		GWL DEPTH 3.4' (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE. TEST PIT	HOLE DIAMETER: PIT	FLUID USED: NA	DATE STARTED: 10-9-08 DATE COMPLETED: 10-9-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE: NA		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.	

DEPTH (FT)	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5	①	X				BROWNISH COLOR - SOIL	
1.0	1.0					SILTY SAND WITH GRAVEL	
1.5	②	X				BROWN SOIL - sandy silt	
2.0	2.0					WITH GRAVEL & ROCK (2" TO 8" ϕ)	
2.5	③	X				BROWN SOIL sandy silt	
3.0	3.0					WITH GRAVEL & ROCK, SOIL WET	
3.5	④	X				BROWN SOIL - silty sand	WATER AT 3.4'
4.0	4.0					W/ SOME CLAY, GRAVEL & ROCK SOIL SATURATED	

NOTES

TD= 4.0'

PIT BACKFILLED & COMPACTED

X - SAMPLE COLLECTED, COMPOSIT OF MATERIAL

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico CO PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-13	COORDINATES OR LOCATION:
LOGGED BY: KC CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 0 No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: Backhoe Test Pit	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-14-08 DATE COMPLETED: 10-14-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA	FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOWCOUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Gravel Surface	
1.0						Gray sandy silt and gravel, stiff	
1.5						Brown silty sand and gravel	
2.0							
2.5							
3.0						Gray sandy silt and gravel, stiff	
3.5						Red calcine tailings	
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							
8.0							

NOTES

TD= 8.0

1) Test Pit Backfilled + compacted

x - Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, Co PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-14	COORDINATES OR LOCATION:
LOGGED BY: [illegible] CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH O No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT · FLUID USED: NA	DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5	0.3					Gravel / more course	
1.0	X					Red to dark red tailings (calune) mixed with stained rock & tailings (cream colored) Rock mixed in tailings (2"-14") ~10% rock sandy to silty sand, moist	
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							
8.0	8.0						no water

NOTES

TD= 8.0'

NO WATER

BACKFILLED & COMPACTED

X = SAMPLE collected, Composit of Material

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico CO PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-15	COORDINATES OR LOCATION:
LOGGED BY: CL CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH 0 (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: Backhoe Test Pit HOLE DIAMETER: NA FLUID USED: NA		DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5		X				Light Brown soil, silty Clay with some sand, Large rock (2"-32") ~35-40% rock	
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0	1						
4.5							
5.0							
5.5							
6.0	6.2						no water encountered
6.5						Large rock difficult to dig	
7.0							

NOTES

TD= 6.2'

1) TP 15 and 16 similar soil profiles

2) Test Pit Backfilled + Compacted

X - Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: RICO, CO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-16	COORDINATES OR LOCATION:
LOGGED BY: [signature] CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH ~~0~~ No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:	FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5		X				Gravel on surface	
1.0						Light Brown soil, silty clay	
1.5						with some sand, large	
2.0						rock (2" to ~48")	
2.5						~30-35% Rock	
3.0							
3.5	①						
4.0							
4.5							
5.0							
5.5	5.4						no water encountered
6.0						Large rocks, very difficult excavation	

NOTES

TD= 5.4'

1) TP-16 & TP-15 similar soil profiles

2) Test Pit Backfilled & Compacted

X - Sample collected & Composit of Material

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico Co PROJECT NO.: St. Louis Park	BORING NUMBER: TP-17	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH ~~(ENCOUNTERED)~~ No water GWL DEPTH (STATIC)
DRILLING METHOD: Backhoe Test Pit	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Gravel on surface, Brown sandy	
1.0						silt with some clay and	
1.5						gravel and Rock (2" to 14")	
2.0						Rock content 25%	
2.5							
3.0	2.8					very dark, Brown silty clay with	
3.5						organic material, little to no rock, soil moist	
4.0	4.0					Brown silty clay with	
4.5						some large rock (6" - 14")	
5.0						~5% soil moist	
5.5							
6.0	6.4						
6.5							NO WATER ENCOUNTERED
7.0							

NOTES

TD= ________

1) Test Pit Back filled & Compacted

2) Sample collected, Composit of Material

TP-17

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico Co PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-18	COORDINATES OR LOCATION:
LOGGED BY: KC CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH: no water (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: Backhoe Test Pit	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-14-08 DATE COMPLETED: 10-14-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:	FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Brown clayey silt with gravel and Cobble (3" - >12" Ø) ~10% rock moist	
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							

NOTES

TD= 7.0

1) Test Pit Backfilled & Compacted

x - Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico Co PROJECT NO.: St. Louis Ponds	BORING NUMBER: TP-19		COORDINATES OR LOCATION:
LOGGED BY: KC CHECKED BY:	SURFACE ELEVATION:		GWL DEPTH 0 NO WATER (ENCOUNTERED) GWL DEPTH ~~(STATIC)~~
DRILLING METHOD: Backhoe Test Pit	HOLE DIAMETER: NA	FLUID USED: N/A	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. NA FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Brown clayey silt with gravel and rock (2-12" Ø), moist	
1.0						25-30% rock	
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5	4.4						
5.0						Concrete foundation	refusal
5.5							
6.0							
6.5							
7.0							

NOTES

TD= ________

1) Test Pit Back filled & Compacted

X) Sample Collected, Composit of Material

ANDERSON

BORING LOG

PAGE ____ OF ____

PROJECT NAME: Rico Co PROJECT NO: St. Louis Ponds		BORING NUMBER: TP-20	COORDINATES OR LOCATION:
LOGGED BY: KC CHECKED BY:		SURFACE ELEVATION:	GWL DEPTH: 0 None (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: Backhoe Test Pit	HOLE DIAMETER: NA	FLUID USED: NA	DATE STARTED: 10-14-08 DATE COMPLETED: 10-14-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Brown clayey silt with gravel and some Cobbles (6"-12" Ø) 5-10% Rock	
1.0							
1.5							
2.0							
2.5							
3.0						Lens of Red calcine tailings @ 3'	
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							

NOTES

TD= 7.5

Piece of Concrete foundation w/ end of pit at 2' deep
metal debris found in zone containing the calcine tailings
Test Pit Backfilled + Compacted
X- Sample Collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico Co PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP 21	COORDINATES OR LOCATION:
LOGGED BY: KC CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH: 0 (ENCOUNTERED) GWL DEPTH: no water (STATIC)
DRILLING METHOD: BACK HOE TEST PIT	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:	FROM ___ A.G.S TO ___ B.G.S. NA FROM ___ TO ___ B.G.S.	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Brown silty sand and gravel	
1.0	(1)						
1.5							
2.0	2.0						
2.5	(2)					White and yellow crushed rock	
3.0	3.0					Mine waste (3-6" Ø) rock 60% rock	
3.5						Brown silty sand with gravel	
4.0						and cobble 10-15% rock	
4.5							
5.0							
5.5	(3)						
6.0							
6.5							
7.0	7.0						No water encountered
7.5						TD ↑	

bmm

NOTES

TD= 7.0

1) Test Pit Backfilled + Compacted

2) Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, Co PROJECT NO. St Louis Ponds	BORING NUMBER: TP-22	COORDINATES OR LOCATION:
LOGGED BY: KC/CS CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH no water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: Back hoe Test Pit	HOLE DIAMETER: NA FLUID USED: NA	DATE STARTED: 10-13-08 DATE COMPLETED: 10-13-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. NA FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5	1	X				Crushed stone and solidified Red Sandy tailings - calcine	
1.0	1.0						
1.5		X				Orange Silty Sand with gravel & cobbles - mine waste	
2.0	2 2.0						
2.5		X				Brown silty sand with gravel and cobbles	
3.0							
3.5	3						
4.0							
4.5							
5.0	5.0						
5.5						TD	Large rocks, could not remove - refusal
6.0							
6.5							No water encountered

NOTES

TD= 5.0

1) Steel pipe in trench, running N/S at 1.2' deep. Pipe 9" Ø

2) Test Pit Back filled + Compacted

X - Sample collected, Composite of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: Rico, CO PROJECT NO.: ST LOUIS PONDS	BORING NUMBER: TP-23	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH: No water (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: PIT / FLUID USED: NA	DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE: NA		FROM ____ A.G.S TO ____ B.G.S. FROM ____ TO ____ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5						Gravel on surface	
1.0						Dark brown, silty sand	
1.5						with gravel	
2.0							
2.5							
3.0	2.8					Red tailings (calcine) with	
3.5						rock (2" - 8") ~10% rock	
4.0	3.9					Brown soil, clay silt with	
4.5						minor sand, mixed with	
5.0						tailings (cream colored tails)	
5.5						Contains gravel and	
6.0	6.2					rock (2" - 12") ~15-20%	
6.5						Large rock at 6.2, could not dig pit - refusal	
7.0							

NOTES

TD= 6.2'

No Water
Backfilled and Compacted
X = Sample collected, Composit of Material

ANDERSON

BORING LOG

PAGE 1 OF 1

PROJECT NAME: RICO, CO PROJECT NO. ST LOUIS PONDS	BORING NUMBER: TP-24	COORDINATES OR LOCATION:
LOGGED BY: CA CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH ~~0~~ No water (ENCOUNTERED) GWL DEPTH (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIAMETER: NA / FLUID USED: NA	DATE STARTED: 10-10-08 DATE COMPLETED: 10-10-08
CASING TYPE AND SIZE: NA SCREEN TYPE AND SIZE:		FROM ___ A.G.S TO ___ B.G.S. FROM ___ TO ___ B.G.S.

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0.5		X				Red Tailings - silty sand with some rock (2"-8") less than 5% rock (calcine)	
1.0							
1.5							
2.0							
2.5							
3.0							
3.5	1						
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							
8.0	7.9						no water

NOTES

TD= 7.9'

Backfilled and Compacted

X = Sample collected, Composit of Material

TP-24

SEH 2004

10:00 AM EXCAVATE TP-2004A
0' - 10.5' CAT 436B RUBB TIRE BACKHOE
COLLUVIUM, CLAYEY SAND AND
GRAVEL, DARK REDDISH GRAY
(3/1), BOULDERS TO 2.0',
MOIST, MODERATELY DENSE
BOULDERS AND COBBLES
SUBROUNDED TO ANGULAR,
ESTIMATE 30% >2"

TP-2004A

TP-2004 B
0 - 7.0' COLLUVIUM
, CLAYEY SAND AND GRAVEL
BROWN (4/3), MOIST, MOD
DENSE, LOW PLASTISITY
FINES, BOULDERS TO 1.0',
COBBLES AND BOULDERS
ANGULAR, TO SUBANGULAR
ESTIMATE 20% > 2"

TP-2004B

TP-2004 C
0 - 9.0' COLLUVIUM
CLAYEY SAND AND GRAVEL
DARK BROWN (3/2), SLIGHTLY
MOIST, FINES LOW TO MOD
PLASTICITY, BOULDERS TO 3.0'
ESTIMATE 15% > 2". COBBLES
ANGULAR TO SUBANGULAR

TP-2004C

TP-2004 D
0.0 - 1.5' TOPSOIL
1.5 - 6.0' COLLUVIUM
SILTY GRAVELLY SAND,
DARK REDDISH BROWN (3/4),
SLIGHTLY MOIST, LOOSE,
BOULDERS TO 1.0', SUBROUNDED
TO SUB ANGULAR. ESTIMATE
5-10% > 2"

TP-2004D

TP-2004 E
N. OF POND 18 IN CALCINE
TAILINGS
0'-9.0' Calcine Tailings
9.0-12.0' RIVER COBBLES
WATER @ 8.0'

TP-2004E

- TP-2004 F
EAST OF POND 18
0-0.5' FILL
0.5-12.0' CALCINE TAILINGS

TP-2004F

TP-2004 G
EAST OF POND 18
0-0.5 FILL
0.5-12.0' Calcine tailings

TP-2004G

TP-2004 H
POND 16/17
0-4.0' FILL
4.0'-12.0' Calcine tailing
GW@ 11.0'

TP-2004 H

TP-2004 I
POND 16-17
0-12.0' Calcine Tailings
~~GW~~ GW@ 12.0'

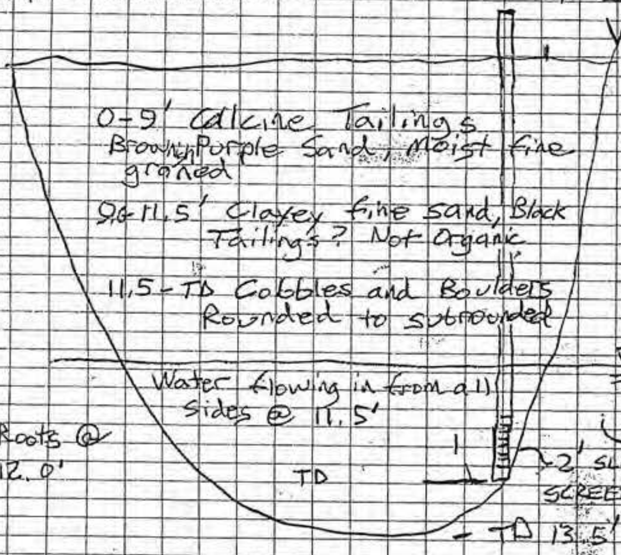
3 SAMPLES EACH PIT

TP-2004I

SEH 2001

TP-A.

2:33 PM
TP-A ~~~ 13 Paces N-NE of Stake 18 D



STA	~~BS~~	HI	~~ES~~
18D	9.15		
TOP PIEZO			5.36
E.G.			8.19

2" PVC CASING

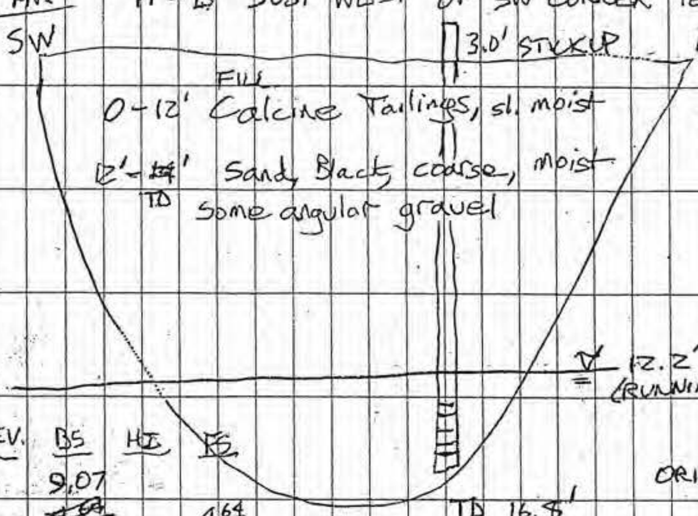
Large Roots @ 12.0'

INITIAL PIEZO LENGTH 21.8'

CUT OFF 6.85'

TP-B

3:40 PM | TP-B JUST WEST OF SW CORNER TEST CELL #5



2" PVC CASING

STA	ELEV.	BS	HI	FS
18-J		9.07		
TOP CASING		~~4.64~~	4.64	
Ex. Gnd				

ORIG. PIEZ. LENGTH 21.8'

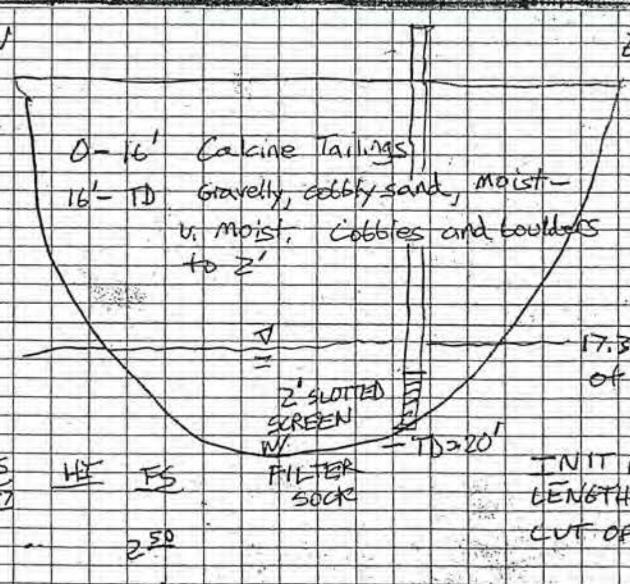
CUT OFF 1.95'

TP-C

4:10 PM

TP-C

54' YARDS DUE EAST OF 18-G HUB NEAR EDGE OF ROAD ~~5' N. OF~~ ~20' S. OF LINE THRU 18-A, 18-G



2" PVC CASING

STA	~~ELEV~~	BS	HI	FS
18-G		3.87		
TOP CASING			2.50	
Ex. GND			5.90	

INITIAL CASING LENGTH 28.3'

CUT OFF 5.13'

ANDERSON Engineering Company, Inc.
975 West 2100 South, Suite 100
Salt Lake City, Utah 84119
BUS (801) 972-6222
FAX (801) 972-6235

SAMPLING METHOD: BACKHOE PIT

LOGGED BY: JOEL MARTINEAU

ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-1
SHEET 1 OF 1
DATE STARTED: 10 APR '96
DATE COMPLETE: 10 APR. '96
TOTAL DEPTH: 3.0.
SURFACE ELEV: 8885
X: N 26680 Y: E. 20135

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0			SURFACE HAS ROCKS EXPOSED
APB-1				SC-CL OH -GW	0-0.7 Root ZONE SOIL GRAYish Brown SANDY-clay to clay w/ ORGANIC MATERIAL AND Minor GRAVEL TO 1CM SIZE. Some Large Rock Sizes, scattered.
	0-3'	1			0.8 - 3.0 FT Brown soil w/ Isolated Sub-rounded rock Texture SC-CL. EST 5% Rock > 3". Rock Fragments To 4 CM, subangular.
		2			
		3			

ANDERSON Engineering Company, Inc. 975 West 2100 South, Suite 100 Salt Lake City, Utah 84119 BUS (801) 972-6222 FAX (801) 972-6235	ARCO	BORING NO. APB-2
SAMPLING METHOD: BACKHOE	RICO RECLAMATION	SHEET 1 OF 1
		DATE STARTED: 10 APR 1996
		DATE COMPLETE: 10 APR 1996
	BORROW MATERIAL	TOTAL DEPTH: 3.0'
		SURFACE ELEV: 8853
LOGGED BY: J. MARTINEAU		X: N 26710 Y: E 19940

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
APB-2	0-3'	0		SM-CL + GW	0-1.0' Root ZONE NO NOTICABLE ORGANICS Color Reddish-BROWN TO Yellow-BROWN (Limonitic + Hematitic) FINES SANDY SILT AND CLAY Rocks Mostly Sub-angular
		1		SM-CL + GW	1.0' - 3.0' SIMILAR TO ABOVE LARGER Rock INCREASING Percentage Largest size 1.5 x 1.2 x 1.7 Two others OVER 1' Screen SIZE
		2			
		3			

ANDERSON Engineering Company, Inc.
975 West 2100 South, Suite 100
Salt Lake City, Utah 84119
BUS (801) 972-6222
FAX (801) 972-6235

SAMPLING METHOD: Backhoe

LOGGED BY: J. MARTINEAU

ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-3

SHEET 1 OF 1

DATE STARTED: 10 APR 96

DATE COMPLETE: 10 APR 96

TOTAL DEPTH: 3.0

SURFACE ELEV: 8836

N 26400 E 20000

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
APB-3	0-3'	0		GW-SC-CL	NO NOTICABLE ORGANIC HORIZON
		1			BROWN Soil-Rock Mixture Subangular Rock - consistent gradation from Top to Bottom. (GROUND FROZEN TO 2.5 Ft)
		2			
					Bottom 3" water
		3			

ANDERSON Engineering Company, Inc.
975 West 2100 South, Suite 100
Salt Lake City, Utah 84119
BUS (801) 972-6222
FAX (801) 972-6235

SAMPLING METHOD: BACK HOE
VISUAL ONLY

LOGGED BY: J. MARTINEAU

ARCO

RICO RECLAMATION

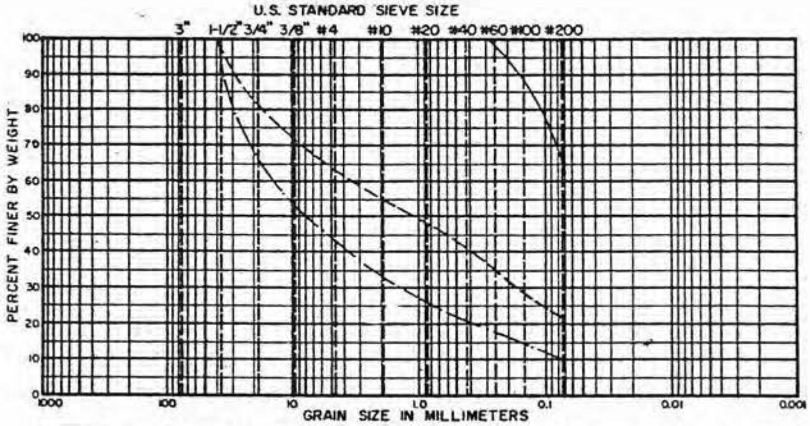
BORROW MATERIAL

BORING NO. PPB-4
SHEET 1 OF 1
DATE STARTED: 10 APR 96
DATE COMPLETE: 10 APR 96
TOTAL DEPTH: 3.0 ft
SURFACE ELEV: 8828
X: E Y: N
19870 26475

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
NONE Taken - VISUAL ONLY	N/A	0			← water level - sits in River Gravels
				GW-GP	mostly sand & gravel. No soil Horizons
		1			Fines About 45-50%
					3-12" Rock 45%
					>12" 3-5%
		2			This Material consists mostly of Rounded Rock + River Gravel; SANDY FINES
		3			

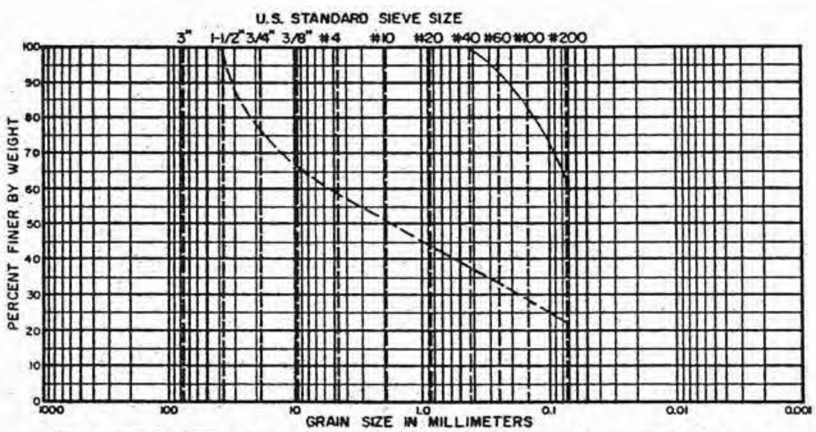
Geotechnical Data

- Dames and Moore, 1981
- Potential Borrow Sources Geotechnical Properties
- Potential Borrow Sources Agronomic Properties



COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT OR CLAY

LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-9~~	~~19.5 Feet~~	~~Fine Sandy Silt (ML)~~	————
B-2	9.5 Feet	Yellow and Brown Fine to Coarse Clayey Sand With Some Gravel (SC)	- - - - -
B-8	9.5 Feet	Brown Sandy Fine Gravel With Clay (GM)	—·—·—

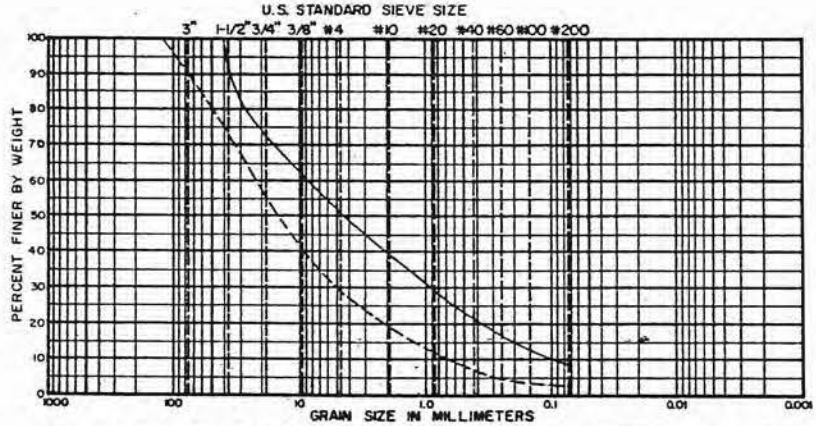


COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT OR CLAY

LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-11~~	~~20 Feet~~	~~Fine Sandy Silt (ML)~~	————
B-4	9.5 Feet	Brown Fine to Coarse Clayey Sand With Gravel (SM-SC)	- - - - -

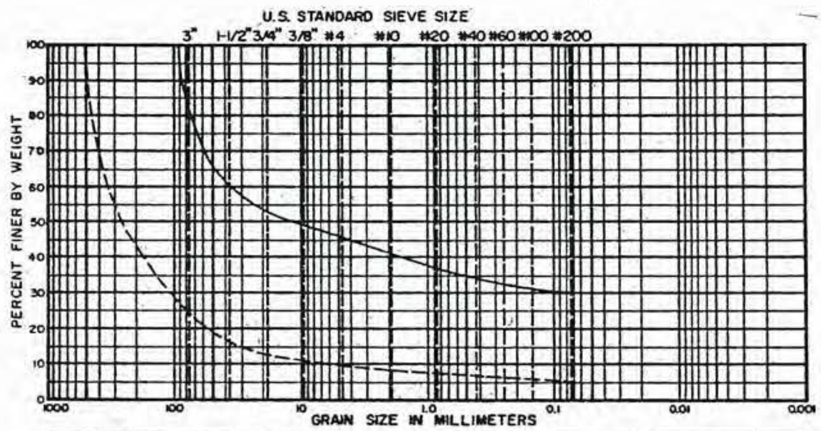
GRADATION CURVES

DAMES & MOORE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LOCATION	DEPTH	CLASSIFICATION	KEY
St. Louis Adit Borrow	From Cut Above Adit	Brown to Lt. Brown Sandy Fine Gravel and Gravelly Fine to Coarse Sand With Silt (GM-SM)	———
~~Near Boring B-13~~	~~0 to 1 Foot~~	~~Fine to Coarse Gravel and Sand (GW)~~	- - - - -



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LOCATION	DEPTH	CLASSIFICATION	KEY
Dolores River	River Bank	Brown Silty Clayey Fine to Coarse Gravel With Cobbles (GM-GC)	———
Dolores River	River Bed	Sandy Gravel and Cobbles (GP)	- - - - -

GRADATION CURVES

DAMES & MOORE

SAMPLE NO. – DEPTH – ELEVATION –

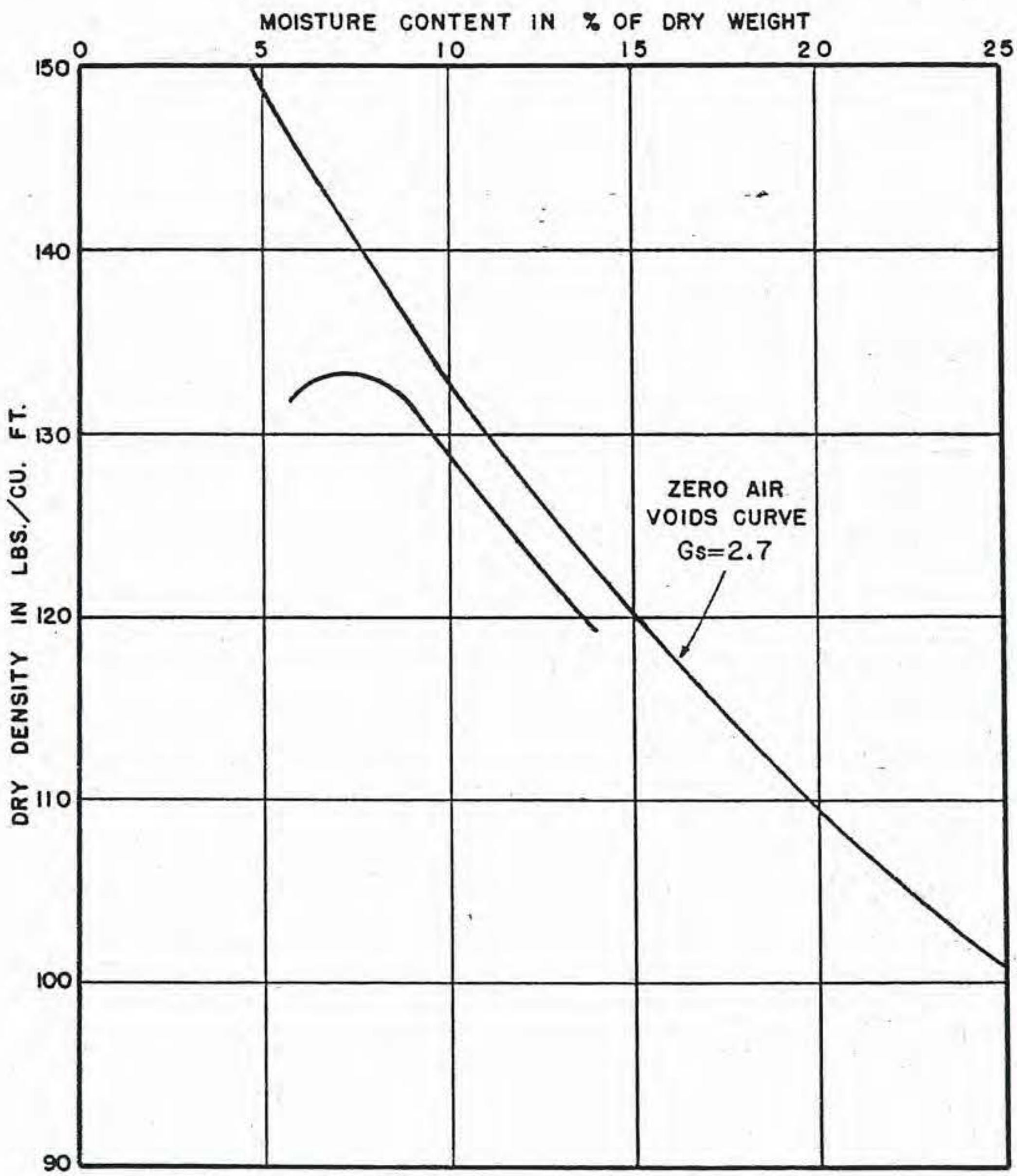
SOIL Sandy Gravel and Gravelly Sand (GM–SM)

LOCATION Cut Above St. Louis Adit

OPTIMUM MOISTURE CONTENT 7.5 Percent

MAXIMUM DRY DENSITY 133 Pounds Per Cubic Foot

METHOD OF COMPACTION ASTM D–1557 Method C



COMPACTION TEST DATA

CHECKED BY DATE

BY DATE

BY DATE

04010-082-1605

DAMES & MOORE

956.1 (REV. 4-57)

PLATE A-5A

SAMPLE NO. – DEPTH – ELEVATION –

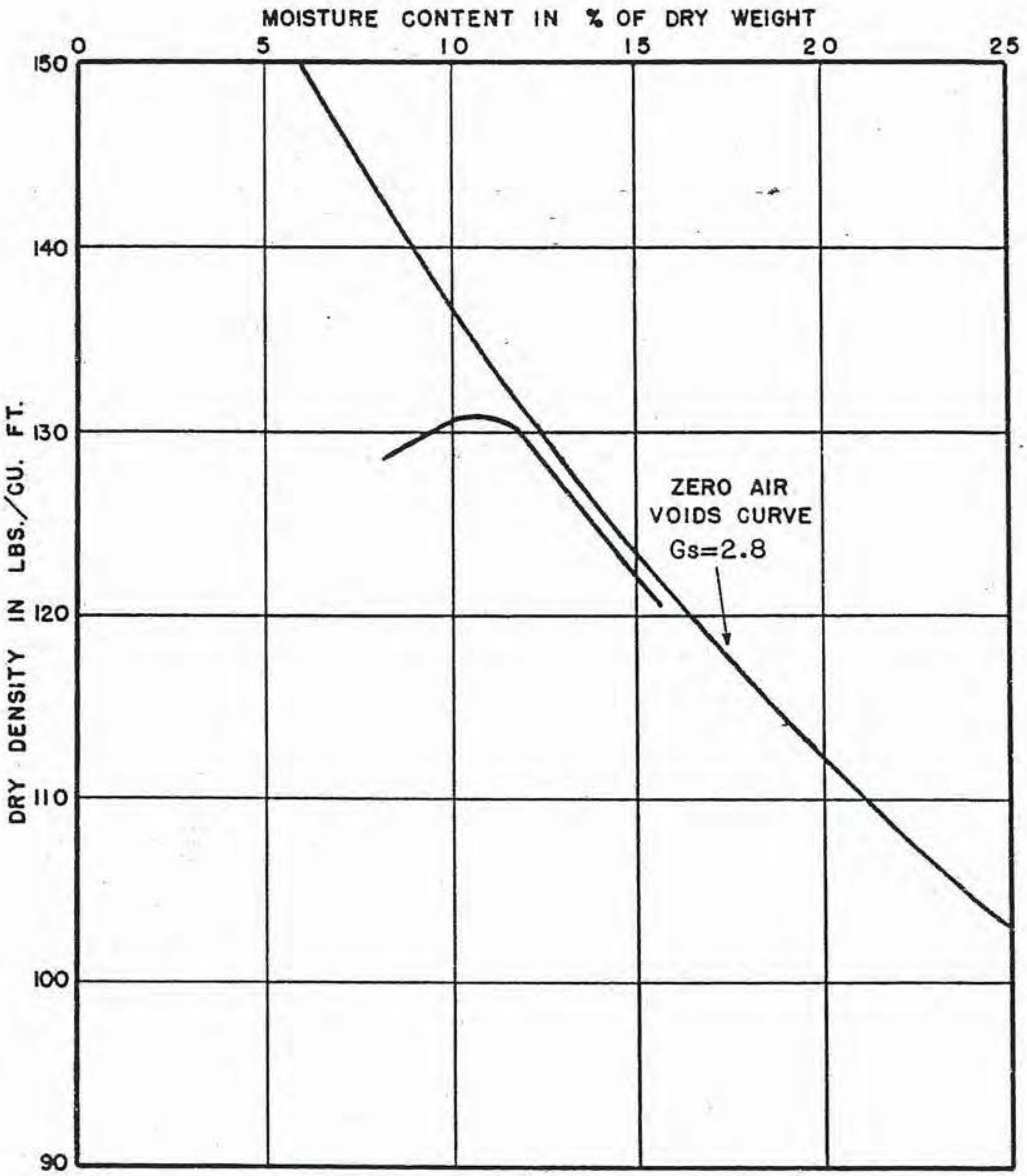
SOIL Brown Silty Clayey Gravel (GM-GC)

LOCATION Dolores River Bank Material

OPTIMUM MOISTURE CONTENT 11 Percent

MAXIMUM DRY DENSITY 131 Pounds Per Cubic Foot

METHOD OF COMPACTION ASTM D-1557 Method C



COMPACTION TEST DATA

DAMES & MOORE

04010-082-1605

Potential Borrow Sources Geotechnical Properties

GRADATION
(cumulative percent passing)
Sample ID

Sieve	TP20004A-1	TP20004A-2	TP20004B	TP20004C	TP20004D	Line Camp Pit	Hay Camp Pit	Mountain Stone Pit - Top Soil	Mountain Stone Pit - 3/4"
	St. Louis Ponds Site Sources					**Off-Site Sources**			
4"	88	82	100	100	100	100	100	100	82
3"	88	80	97	97	100	100	100	100	80
2.5"	81	79	94	89	100	100	100	100	79
2"	80	75	92	87	98	100	100	100	75
1.5"	73	69	85	82	92	100	100	100	69
1"	63	62	72	76	89	100	100	100	62
3/4"	60	58	64	72	85	98	100	100	58
1/2"	53	49	53	65	79	96	99	100	49
3/8"	49	46	46	60	77	95	99	100	46
#4	41	38	36	54	68	90	99	99	38
#8	34	30	29	46	62	87	98	98	30
#16	28	24	25	42	56	85	98	95	24
#30	23	20	22	36	50	80	97	92	20
#40	21	17	21	32	46	76	96	91	17
#50	18	15	18	29	40	68	95	88	15
#100	14	12	14	24	28	47	93	75	12
#200	13	10	12	22	24	36	85	65	10

ATTERBERG LIMITS

Index Value (%)	TP20004A-1	TP20004A-2	TP20004B	TP20004C	TP20004D	Line Camp Pit	Hay Camp Pit	Mountain Stone Pit - Top Soil	Mountain Stone Pit - 3/4"
Liquid limit	26	28	31	26	21	21	28	29	no LL
Plastic Limit	18	18	20	18	17	18	20	19	no PL
Plasticity Index	8	8	11	8	4	3	8	10	non plastic
Moisture Content	14.9	12.4	13.8	11.8	9.2	14.9	4.1	12.1	4.7

POTENTIAL BORROW SOURCES AGRONOMIC PROPERTIES

	Agronomic Data									Saturated Paste Extract										
Sample ID	EC as mmho/cm	N -ppm as N03	Bicarb P -ppm as P	Bray Weak P -ppm as P	K -ppm as K	pH as units	Organic Matter as %	CEC meq/100	Saturation Percent	Mg Meq/L	Ca Meq/L	Na Meq/L	SAR	Mg as ppm	Ca as ppm	CaCO3 as %	T - S as %	Neutralization Potential Tn/1000Tn	Acid Potential Tn/1000Tn	Acid-Base Potential Tn/1000Tn
St. Louis Ponds Site Sources																				
TP2004 4A-a		1	2		78	6.9	1.2	17.1						232	2992	0.825	0.197	8.25	6.15	2.10
TP2004 4A-b		1	4		70	7.5	1.0	13.4						191	2332	1.08	0.041	10.80	1.28	9.53
TP2004 4B		1	1		54	8.1	0.6	16.0						190	2851	3.286	0.036	32.90	1.13	31.70
TP2004 4C		1	2		72	7.8	1.0	10.8						94	1957	0.365	0.015	3.65	0.48	3.16
TP2004 4D		2	1		69	7.9	1.3	11.0						89	2023	2.212	0.048	22.10	1.50	20.60
Off-Site Sources																				
Line Camp Pit - Top Soil		8	1		68	7.7	1.3	8.0						117	1378	1.541	0.068	15.40	2.14	13.30
Line Camp Pit (earlier sample)					151	7.6	2.1	10.7						187	1752					
Hay Camp Pit	0.34	6		26	304	6.7	2.4	14.2	43.7	0.72	2.41	0.57	0.45	314	2152	0.117	0.021	1.17	0.66	0.51
Hay Camp Pit (earlier sample)					270	7.1	3.3	12.3						246	1910					
Mountain Stone Pit - Top Soil	1.76	91	5		111	7.5	1.9	16.1	49.3	3.85	13.8	1.38	0.47	253	2740	1.336	0.019	13.4	0.59	12.8
Mountain Stone Pit - 3/4"	0.31	1	3		72	8.3	0.5	9.2	23.5	0.48	2.25	0.95	0.82	78	1670	1.847	0.038	18.5	1.18	17.3

	USDA Textural Data (see note)					Total Soil Metals Data (Nitric Acid Digest) (mg/kg)								Plant Available Soil Metals Data (Bicarb DTPA) (mg/kg)				
Sample ID	Percent Sand	Percent Silt	Percent Clay	USDA Class	Percent Course Fragments	B	Cd	Cu	Fe	Pb	Mn	Mo	Zn	B	Cu	Fe	Mn	Zn
St. Louis Ponds Site Sources																		
TP2004 4A-a	68.8	18.8	12.5	silty loam	36.0	49.4	8.4	48.4	22100	187	1250	<1.0	230					
TP2004 4A-b	70.0	16.3	13.8	silty loam	36.0	46.9	7.6	38.6	21200	60.1	1110	<1.0	161					
TP2004 4B	63.8	18.8	17.5	silty loam	47.0	64	11.8	47.0	30800	116	1720	3.2	240					
TP2004 4C	65.0	18.8	16.3	silty loam	13.0	20.1	2.8	15.5	7780	23.5	353	<1.0	45.4					
TP2004 4D	66.3	18.8	15.0	silty loam	22.5	43.4	7.0	54.7	17500	328	837	4.3	246					
Off-Site Sources																		
Line Camp Pit - Top Soil	60.0	21.3	18.8	silty loam	31.0	65.3	15.4	117	30800	613	2130	3.6	920					
Line Camp Pit (earlier sample)														0.6	2	41	11	3.2
Hay Camp Pit	46.3	31.3	22.5	loam	<2.0	NT	3.4	NT	NT	12	NT	<1.0	NT					
Hay Camp Pit (earlier sample)														0.7	1.5	38	17	2.3
Mountain Stone Pit - Top Soil	46.3	32.5	21.3	loam	0.0	29.1	2.7	14.8	7970	12.5	384	<1.0	46.1					
Mountain Stone Pit - 3/4"	87.5	8.8	3.8	loamy Sand	80.4	31.8	3.5	160	11100	15.8	459	<1.0	136					

Note: USDA Textural Data was determined on samples that had been screened to remove material over 3/4"

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 14

Summary of site history and operation

Summary of site history and operation

The history of the St. Louis Ponds site area is dominated by historic mining-related activity and the associated narrow gauge railroading. Mining in the Rico area (known as the Pioneer District) began with the staking of the first claim on lower Silver Creek in 1869 and continued sporadically for more than a century. Important references for the historical information related to mining in the Pioneer District (including the St. Louis Ponds site) have been Ransome (1901)[1] for the early history of operations and McKnight (1974)[2] for the later history. Other references are noted in the text where appropriate. The Rio Grande Southern Railroad (RGS) connecting Ridgeway to the north and Durango to the south arrived in Rico in 1891. The RGS provided freight and passenger service to Rico and the Pioneer District until the line was abandoned in 1951 (McCoy, et. al, 1996)[3].

Significant mining in the vicinity of the St. Louis Ponds site began in the early 1900s and flourished around the First World War at the Mountain Spring-Wellington mine in CHC Hill just north of the St. Louis Tunnel. Mining in the immediate area was expanded with the driving of the St. Louis Tunnel by the St. Louis Smelting & Refining Company (a division of National Lead Company, presently N.L. Industries) during 1930-1931 to explore for deep ore horizons beneath CHC Hill. A major crosscut to the north connected the St. Louis Tunnel to the still active Mountain Spring-Wellington mine. Construction of the St. Louis Ponds system is believed to have begun about this same time, followed by subsequent modifications and additions. A long crosscut to the southeast from the end of the St. Louis Tunnel to an intersection with the Argentine Shaft on Silver Creek was completed in 1955. Available information documents that the upper ponds were present by at least 1956 and the lower ponds by at least 1979.

During 1955 a sulfuric acid plant was constructed and began operation at the St. Louis Ponds site. Between 1955 and 1964 this plant produced approximately 0.3 million tons of sulfuric acid from approximately 400,000 tons of pyrite ore and 80,000 tons of pyritic tailings hauled to the plant (Holmes and Kennedy, 1983)[4].

Rico Argentine Mining Company ceased most mining operations in 1971 and allowed deeper workings beneath Silver Creek to flood. During 1973-1975, Rico Argentine Mining Company operated a leach heap just northwest of the St. Louis Tunnel, immediately adjacent to the Dolores River. All mining activities by Rico Argentine Mining Company ended in 1976-77, and exploration work ceased in 1978.

In 1980, the Anaconda Company acquired Rico Argentine Mining Company's surface and mineral properties in the Rico area.

The Anaconda Company conducted exploration drilling at a number of sites from 1980 to 1983, including at the St. Louis Ponds site, resulting in discovery of a deep molybdenum ore body beneath Silver Creek. Several of these borings were located within the St. Louis Ponds site as shown on Figure 13-1C. However, the depth and hot geothermal waters encountered made this

---

[1] Ransome , F.L., 1901. The Ore Deposits of the Rico Mountains, Colorado; U.S. Geological Survey Annual Report, 22nd, Part 2: 229-398.
[2] McKnight, Edwin T., 1974. Geology and Ore Deposits of the Rico District, Colorado; US Geological Survey Professional Paper 723.
[3] McCoy, Dell A., Coleman, Russ, and William A. Graves, 1996. The RGS Story, Volume V, Rico and the Mines. Sundance Publications, Ltd. Denver, Colorado.
[4] Holmes, Richard Walker and Marrianna B. Kennedy, 1983. Mines and Minerals of the Great American Rift (Colorado-New Mexico). Van Nostrand Reinhold Co., New York.

deposit uneconomical and no further exploration or development occurred. Consequently, the Anaconda Company never produced ore or operated milling facilities in Rico. During this same time period, The Anaconda Company performed extensive hazard reduction and environmental clean-up activities in the District, including at the St. Louis Ponds site.

As part of the acquisition of Rico Argentine Mining Company's surface and mineral properties in 1980, a pre-existing NPDES permit (No. CO-0029793) was transferred to The Anaconda Company. In 1983 water from the Blaine Mine on Silver Creek (outfall 002 under the original NPDES permit) was redirected to the St. Louis Tunnel and the Blaine Tunnel (or adit) became zero discharge. In 1984 The Anaconda Company began operation of a new slaked-lime addition plant to treat mine water discharge from the St. Louis Tunnel as it entered the Ponds System. Between 1984 and 1995, slaked lime was added to the tunnel discharge to improve water treatment and solids removal.

The acid plant and associated structures at the St. Louis Ponds site were demolished, and the site was regraded, capped with a soil cover, and revegetated during 1985-1986. Other miscellaneous grading has apparently occurred at various locations in the northern portion of the St. Louis Ponds site.

Atlantic Richfield Company, a successor to The Anaconda Company, sold their Rico properties, including the St. Louis Ponds site, to Rico Development Corporation under a Purchase and Sale Agreement executed in May 1988. The existing NPDES permit transferred to Rico Development Corporation at that time. The Rico Development Corporation then sold/optioned their property holdings, including the St. Louis Ponds site and the NPDES permit, to others in April 1994. While owned by Rico Development Corporation, it is believed that borrow excavation over the portal area of the tunnel in about 1996 resulted in local collapse of the tunnel roof and walls. Around this time it appears that use of the slaked lime system was discontinued and mechanical components were removed (the plant building is still present at the site).The NPDES permit apparently expired in 1999 after this latest property transfer.

In 2001 dispersed surface flows resulting from the previously described tunnel portal collapse area were collected into a common channel, diverted through a Parshall flume, and re-routed to Pond 18 by Atlantic Richfield Company. Also, ongoing clearing/maintenance of existing hydraulic facilities/structures and construction of some new controlled overflows (spillways) in the ponds flow system have been implemented by Atlantic Richfield Company at various times over the past approximately 10 years.

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 15

2008 Water Quality Assessment

APPENDIX A
WATER QUALITY ASSESSMENT
MAINSTEM OF THE DOLORES RIVER
ST. LOUIS TUNNEL DISCHARGE

Table A-1 Assessment Summary	
Name of Facility	St. Louis Tunnel
CDPS number	To Be Decided (Previous Permit CO-0029793 expired)
WBID - Stream Segment	San Juan River Basin, Dolores River Sub-basin, Stream Segment 03: Mainstem of the Dolores River from a point immediately above the confluence with Horse Creek to a point immediately above the confluence with Bear Creek. COSJDO03
Classification	Cold Water Aquatic Life Class 1 Class E Recreation Agriculture
Designation	Undesignated

I. Introduction

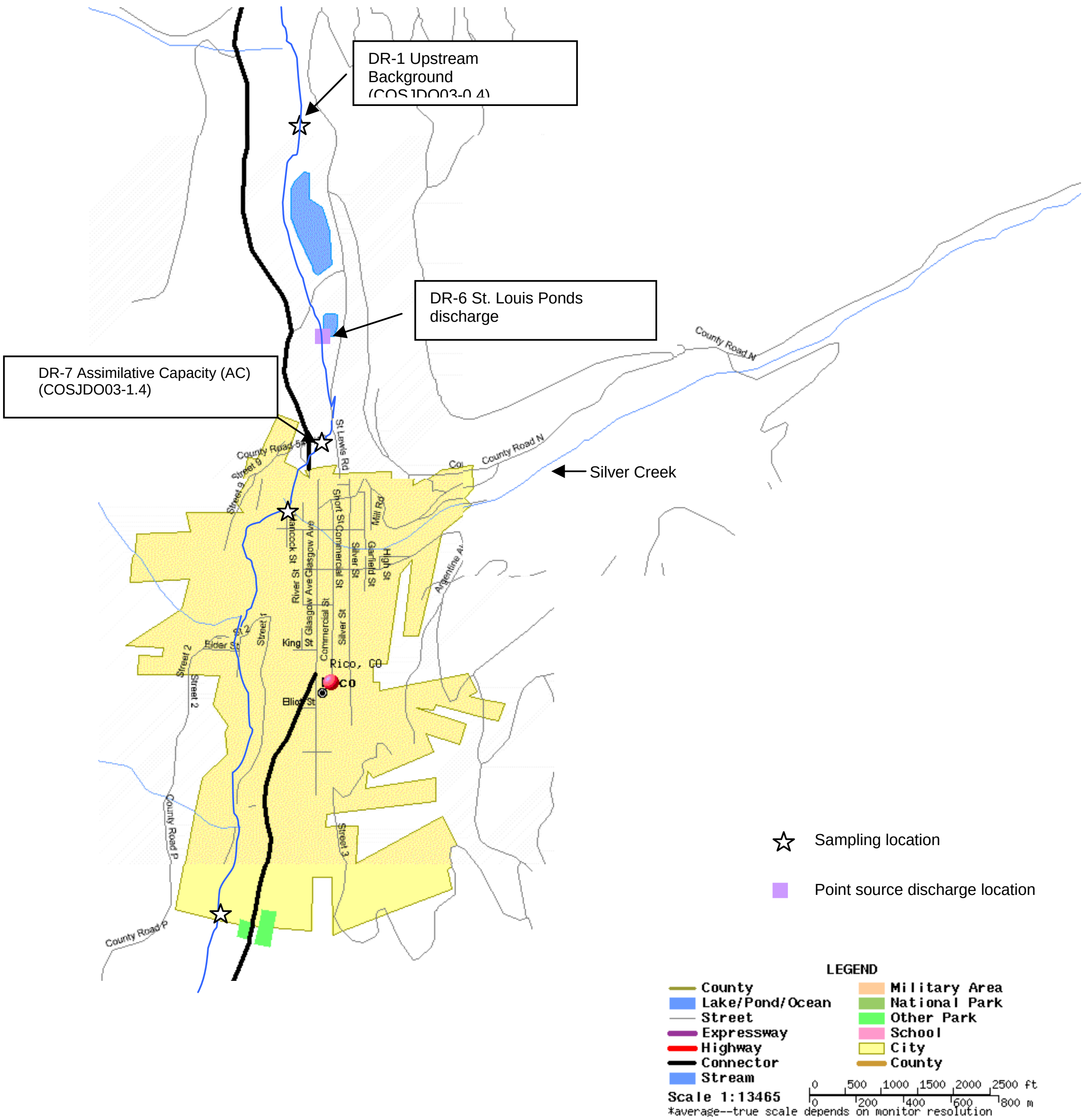
The water quality assessment (WQA) of the Dolores River near the St. Louis Tunnel discharge was developed by the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD). The WQA was prepared to facilitate issuance of a Colorado Discharge Permit System (CDPS) permit for the St. Louis Tunnel, formerly covered under CDPS Permit No. CO-0029793, and is intended to determine the water quality-based effluent limits (WQBELs) and antidegradation-based average concentrations (ADBACs) available to the St. Louis Tunnel discharge for pollutants found to be of concern. This assessment provides potential effluent limits for the discharge of the St. Louis Tunnel.

The St. Louis Tunnel discharge is located north of the Town of Rico, upstream of the confluence with Silver Creek. The St. Louis Tunnel discharge flows from the tunnel through a series of settling ponds, once used for treatment, before discharging to the Dolores River. It should be noted that the discharge from the St. Louis Tunnel was previously covered under a permit held by the Rico Development Corporation. Due to the dissolution of the Rico Development Corporation and other circumstances in 1996, the operation and maintenance of the St. Louis Tunnel pond treatment system was abandoned and the expired permit was never renewed. Thus, the St. Louis Tunnel has been discharging mine drainage for the past 10 years with only passive settling of naturally precipitated metals as the flow passed through the pond system. An evaluation of existing in-stream water quality data shows that applicable water quality standards for the Dolores River are not being exceeded within Segment COSJDO03 except relative to the new cadmium standard. Herein the St. Louis Tunnel's current pond system will be referred to as the St. Louis Pond System, and the future treatment system will be referred to as the St. Louis Treatment System. Figure A-1 on the following page contains a map of the study area evaluated as part of this WQA.

The Dolores River from above the St. Louis Tunnel to below the Silver Swan Adit (approximately 2.5 river miles) has been studied extensively over the last 25 years by numerous entities and at different times. This includes an intense monitoring effort by Atlantic Richfield from 2000 forward, after it was recognized early in the WQA process that there were data gaps needing to be filled. Because of an inconsistent and disparate numbering system used in the identification of sampling locations by multiple entities, this WQA utilizes yet another numbering system as shown in Figure A-1 to enable the reader to better understand the various data. Specifically, this WQA uses the water body identification (WBID) number for each stream segment combined with the distance from the beginning of the stream segment. This numbering system is used to identify the ambient water quality sampling locations and the confluence locations of other discharges.

Information evaluated as part of this assessment includes data gathered from the Atlantic Richfield Company and its consultants, the Town of Rico, Department of the Interior, WQCD, Colorado Division of Water Resources (DWR), U.S. Environmental Protection Agency (EPA), U. S. Geological Survey (USGS), and the local water commissioner. The actual data used in the assessment consist of the best information available at the time of preparation of this WQA package.

Figure 1 - WQA Study Area



II. Water Quality

The St. Louis Tunnel discharges to the WBID stream segment COSJDO03, which means the San Juan River Basin, Dolores River Sub-basin, Stream Segment 03. This segment is composed of the "Mainstem of the Dolores River from a point immediately above the confluence with Horse Creek to a point immediately above the confluence with Bear Creek." Stream segment COSJDO03 is classified for Cold Water Aquatic Life Class 1, Class E Recreation, and Agriculture. The standards in Table A-2 will be assigned to stream segment COSJDO03 in accordance with the *Classifications and Numeric Standards for San Juan and Dolores River Basins*.

Note that revisions to the *Classifications and Numeric Standards for San Juan and Dolores River Basins* were adopted by the Water Quality Control Commission (WQCC) as of February 12, 2007 and became effective as of July 1, 2007. Included in the revisions were changes to the water quality standards for total recoverable arsenic, dissolved cadmium, and dissolved zinc. The revised water quality standards are incorporated into the calculations of potential effluent limits in this WQA.

Statewide Basic Standards have been developed in Section 31.11(2) and (3) of *The Basic Standards and Methodologies for Surface Water* to protect the waters of the state from radionuclides and organic chemicals. In Section 31.11(1) of the regulations, narrative standards are applied to any pollutant of concern, even where there is no numeric standard for that pollutant. Waters of the state shall be "free from harmful substances in harmful amounts." Total dissolved solids (TDS) and sediment are such pollutants of concern discussed by Agricultural and Water Quality Standards workgroups. In order to protect the Basic Standards in waters of the state, effluent limitations with monitoring, or "monitoring only" requirements for radionuclides, organics, TDS, or any parameter of concern could be put in CDPS discharge permits.

Numeric standards are developed on a basin-specific basis and are adopted for particular stream segments by the WQCC. To simplify the listing of the segment-specific standards, many of the aquatic life standards are contained in a table at the beginning of each chapter of the regulations. Standards for metals are generally shown in the regulations as Table Value Standards (TVS), and these often must be derived from equations that depend on the receiving stream hardness or species of fish present. The Classifications and Numeric Standards documents for each basin include a specification for appropriate hardness values to be used. Specifically, the regulations state that:

> "The hardness values used in calculating the appropriate metal standard should be based on the lower 95% confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not appropriate, a site-specific method should be used."

Hardness data for the Dolores River downstream of the St. Louis Pond System discharge were sufficient to conduct a regression analysis using flow data from the USGS Gage Station 09165000 located approximately five miles below the St. Louis Ponds discharge. A regression analysis (Figure 2) was conducted using flow data from the USGS Gage Station and hardness data from sampling location COSJDO03-1.4, which is located downstream of the pond system outfall. Flow data from the USGS Gage Station was used in the regression because it provided more paired data sets to conduct a regression analysis and because flow data from the USGS Gage Station correlated well with the flow data available for sampling location COSJDO03-1.4 (R^2 = 0.9460). Data were available for a period of record from October 1999 through August 2005. Fifteen paired flow and hardness data points were available, but three sets of paired data were excluded as they reflected hardness data collected at times of high flows (i.e., flows greater than 75 cfs). Because of the limited data for this location, the statistical significance of the R^2 = 0.6393 will need to be improved with additional data in the future when the data become available. The regression analysis was computed to a low flow of 6.9 cfs, which was the lowest of the measured flows in the data set. The 95th confidence interval of the hardness data was then calculated, resulting in a hardness value equal to 247 mg/l. This hardness value and the formulas contained in the TVS were used to calculate the in-stream water quality standards for metals with the results shown in Table A-3.

Table A-2 **In-stream Standards for Stream Segment COSJDO03**
Physical and Biological
Dissolved Oxygen (DO) = 6 mg/l, minimum
Dissolved Oxygen (DO) = 7 mg/l, minimum (during spawning)
pH = 6.5 – 9.0 su
E. coli = 126 colonies/100 ml
Inorganic
Ammonia acute and chronic = TVS
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide acute = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite = 0.05 mg/l
Metals
Total Recoverable Arsenic acute = 340 µg/l
Total Recoverable Arsenic chronic = 7.6 µg/l
Dissolved Cadmium acute and chronic = TVS
Total Recoverable Trivalent Chromium chronic = 100 µg/l
Dissolved Hexavalent Chromium acute = 16 µg/l
Dissolved Hexavalent Chromium chronic = 11 µg/l
Dissolved Copper acute and chronic = TVS
Total Recoverable Iron chronic = 1000 µg/l
Dissolved Lead acute and chronic = TVS
Dissolved Manganese acute and chronic = TVS
Total Mercury chronic = 0.01 µg/l
Dissolved Nickel acute and chronic = TVS
Dissolved Selenium acute = 18.4 µg/l

Dissolved Selenium chronic = 4.6 µg/l
Dissolved Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS

Figure 2
Hardness Regression

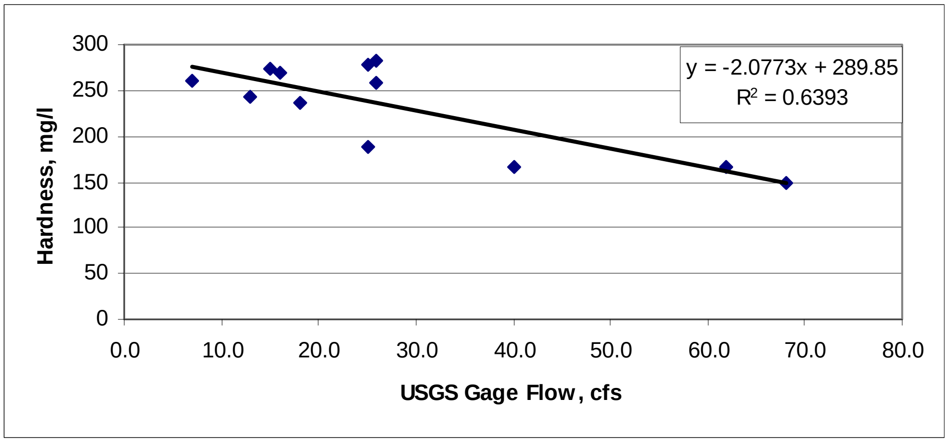


Table A-3				
Water Quality Standards for Metals for Stream Segment COSJDO03 Based on the Table Value Standards Contained in the Colorado Department of Public Health and Environment Water Quality Control Commission *Regulation 34*				
Calculated Using the Following Value for Hardness as $CaCO_3$:			247	mg/l
Parameter	***In-Stream Water Quality Standard***			***Formula Used***
Cadmium, Dissolved	Acute	6.0	µg/l	$[1.136672-(\ln(\text{hardness})*0.041838)]*[e^{(0.9151*(\ln(\text{hardness}))-3.1485)}]$
	Chronic	0.84	µg/l	$[1.101672-(\ln(\text{hardness})*0.041838)]*[e^{(0.7998(\ln(\text{hardness}))-4.4451)}]$
Copper, Dissolved	Acute	32	µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	19	µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Dissolved	Acute	170	µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-1.46)}]$
	Chronic	6.6	µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-4.705)}]$
Manganese, Dissolved	Acute	4035	µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2229	µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Dissolved	Acute	1006	µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	112	µg/l	$e^{(0.846(\ln(\text{hardness}))+0.0554)}$
Silver, Dissolved	Acute	9.6	µg/l	$\frac{1}{2}\, e^{(1.72(\ln(\text{hardness}))-6.52)}$
	Chronic	1.50	µg/l	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Zinc, Dissolved	Acute	310	µg/l	$0.978\, e^{(0.8525(\ln(\text{hardness}))+1.0617)}$

	Chronic	269	µg/l	$0.986\ e^{(0.8525(\ln(hardness))+0.9109)}$

Ambient Water Quality

The WQCD evaluates ambient water quality based on a variety of statistical methods as prescribed in Sections 31.8(2)(a)(i) and 31.8(2)(b)(i)(B) of *The Basic Standards and Methodologies for Surface Water, Regulation 31*. Ambient water quality is evaluated in this WQA for use in determining assimilative capacities for pollutants of concern, and in conducting antidegradation reviews.

It is the general approach of the WQCD to use the most recent five years of data, if available, when determining ambient water quality. Where adequate data are not available in the five-year period, a greater time frame may be evaluated. Data used for this analysis primarily resulted from sampling collected by the WQCD and consultants for Atlantic Richfield. To conduct an assessment of the ambient water quality upstream of the St. Louis Pond System discharge, data were evaluated from sampling location COSJDO03-0.4. Ambient water quality data evaluated at this location include data collected during the period of record from April 1998 through January 2006. More than five years of data were used in order to provide a more robust data set and because there have been no changes in the watershed that would impact water quality.

It is the general approach of the WQCD to summarize ambient water quality data by the 15th, 50th, and 85th percentiles and the mean. When sample results are below detection levels, the value of zero is used in accordance with the WQCD's standard approach for summarization and averaging. These data are summarized in Table A-4.

Table A-4

Ambient Water Quality for Stream Segment COSJDO03-0.4 (µg/l)

Parameter	*Number of Samples*	*15th Percentile*	*50th Percentile*	*85th Percentile*	*Mean*	*Chronic Stream Standard*	*Notes*
As, Trec	4	0	0.3	0.655	0.325	7.6	
Cd, Dis	18	0	0	0.0675	0.189	0.8	
Cr+3, Trec	15	0	0	1.2	4.17	100	1
Cr+6, Dis	5	0	0	0.12	0.06	11	1
Cu, Dis	18	0	0.6	1.6175	1.10	19	
CN, Free	10	0	0	0	0	5	2
Fe, Trec	15	47.9	70	1027	417	1000	
Pb, Dis	18	0	0	0.2	0.106	6.6	
Mn, Dis	18	5.85	14	32.45	21.3	2229	
Hg, Tot	8	0.00002	0.0005	0.0012	0.0013	0.01	3
Ni, Dis	13	0	0	0.092	0.0746	112	
Se, Dis	14	0	0.5	0.7	0.457	4.6	
Ag, Dis	18	0	0	0.0315	0.025	1.5	
Zn, Dis	18	0	2.5	20	6.66	269	

Note 1: Data for total recoverable Cr+3 and dissolved Cr+6 were not available. Instead total recoverable chromium was used for the trivalent form and dissolved chromium was used for the hexavalent form.

Table A-4 Ambient Water Quality for Stream Segment COSJDO03-0.4 (µg/l)							
Parameter	*Number of Samples*	*15th Percentile*	*50th Percentile*	*85th Percentile*	*Mean*	*Chronic Stream Standard*	*Notes*
Note 2: The stream standard reflected herein is the acute stream standard. Because no free cyanide data were available, data reflecting total cyanide were used.							
Note 3: Mercury data is suspect due to contamination in the field blanks. Some of the data may be voided in accordance with Method 1631. See discussion on mercury analytical results below this table.							

The ambient and effluent total mercury samples collected since 2003 were analyzed using EPA Method 1631, which is able to measure low levels of total mercury. The method detection limit (MDL) for Method 1631 is 0.2 ng/l (0.0002 µg/l) and the practical quantitation level (PQL) is 0.5 ng/l (0.0005 µg/l). Due to the very low levels of detection, inadvertent and unavoidable sample contamination can have a significant impact on the total mercury measurement. For this reason, field blanks and method blanks are critical in determining the true concentration of total mercury in the sample. Following the procedure outlined in Method 1631 to void or adjust total mercury measurements based on contamination of field blanks, five of the eight ambient measurements can be considered invalid. The 50th percentile of the remaining three valid ambient samples indicates that there was a non-detectable level of total mercury upstream of the discharge. However, due to the limited amount of data and to ensure water quality protection, the 50th percentile of the eight original samples was used to determine WQBELs. As noted later in this WQA, contamination of field blanks may also be an issue for the effluent total mercury data. Antidegradation limits were not calculated at this time for mercury, because the limits are so low that the issue of contamination needs to be addressed before appropriate limits can be established. More mercury data will be collected in the future to correct the uncertainty with the Hg effluent levels and potential effluent limitations.

III. Water Quantity

The Colorado Regulations specify the use of low flow conditions when establishing water quality based effluent limitations, specifically the acute and chronic low flows. The acute low flow, referred to as 1E3, represents the one-day low flow recurring in a three-year interval. The chronic low flow, 7E3, represents the 7-day average low flow recurring in a three-year period. The chronic low flow, 30E3, represents the 30-day average low flow recurring in a three-year interval.

<u>Low Flow Analysis</u>

To best determine the low flows available in the receiving stream to the St. Louis Treatment System, a flow gage measurement immediately upstream of the discharge should be used. Because there were no flow gages immediately upstream of the current St. Louis Pond System outfall, flows measured at a downstream gage station were used to estimate upstream flows.

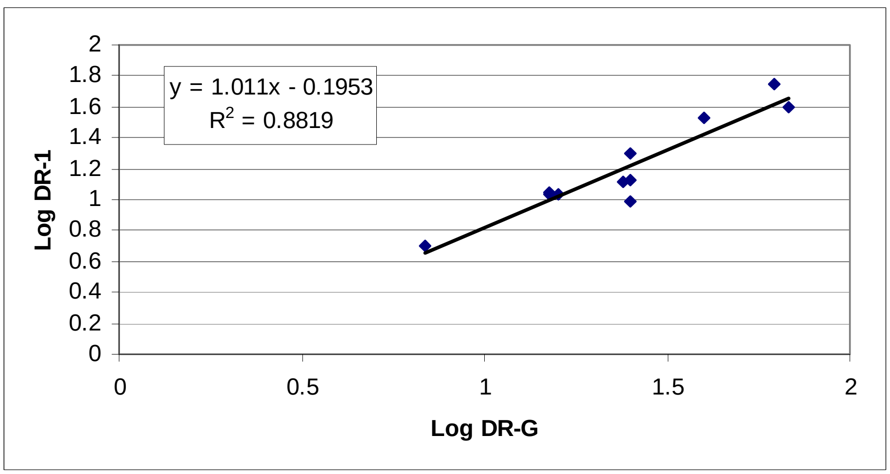
Daily flows from the USGS Gage Station 09165000 (Dolores River near Rico, CO) were obtained for the period of record of October 1, 1993 through September 30, 1996 and from October 1, 1998 through September 30, 2005. The gap in the USGS Gage Station flow data is due to the gage station not being in operation for the period of October 1, 1996 through

September 30, 1998. This gage station and these time frames were deemed the most accurate and representative of current flows and were therefore used in this analysis.

The 1E3 and 30E3 low flows were calculated using U.S. Environmental Protection Agency (EPA) DFLOW software. The output from DFLOW provides calculated acute and chronic low flows for each month. During the months of April, May, and June, the acute low flow calculated by DFLOW exceeded the chronic low flow. In accordance with Regulation 31.9(1) of the Basic Standards and Methodologies for Surface Water, transitional 30E3 low flows were calculated for these months based on the prescribed method of using a forward moving harmonic mean.

To estimate the low flows upstream of the St. Louis Treatment System discharge, a regression analysis (Figure 3) was performed using paired in-stream measured flow at sampling site COSJDO03-0.4 and daily flows measured by the USGS Gage Station 09165000. The equation for the line of best fit was used to convert the calculated low flows at the USGS Gage Station 09165000 to upstream low flows. In the future it will be best to use a lengthy record of actual stream flow measurements from above the discharge point, and this will be done once the data is available.

Figure 3
Stream Flow Regression Analysis



The period of record for paired stream flow data used in the regression analysis was within the same period of record used to calculate low flows at the USGS Gage Station. Note that sample dates were excluded from the regression analysis if there were not matching in-stream flows and USGS Gage Station flows. Additionally, data were excluded as non-representative if they were for high flows above 75 cfs. If a low flow regression has to used in future assessments, the statistical significance of the R^2 = 0.8819 will be improved with additional data when the data become available.

Based on the low flow analysis described, monthly upstream low flows above the St. Louis Treatment System were calculated and are presented in Table A-5.

Table A-5

Low Flows (cfs) for the Dolores River Upstream of the St. Louis Treatment System

Low Flow	*Annual*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1E3 Acute	3.2	3.8	5.7	4.9	22	45	13	7.9	5.6	7.9	9.9	5.9	3.2
30E3 Chronic	6.1	6.1	6.1	6.2	23	45	13	8.5	7.9	7.9	11	6.1	6.1

The 7E3 low flow was calculated to be 4.0 cfs from the same data used to calculate the 1E3 and 30E3 low flows.

Mixing Zone Considerations

The mixing ratio is < 20:1 dilution. Therefore other mixing zone considerations will apply, and would be implemented through the permit. The other allowed exemptions from mixing zone constraints must be investigated according to the Colorado Mixing Zone Implementation Guidance. Any dilution reductions will be decided by the permittee and Division, after these investigations.

IV. Technical Analysis

In-stream background data and low flows evaluated in sections II and III are ultimately used to determine the assimilative capacity of the receiving waters below the St. Louis Treatment System discharge for pollutants of concern. The WQCD’s normal approach is to conduct a technical analysis of stream assimilative capacity using the lowest of the monthly upstream low flows (referred to as the annual low flow) as calculated in the low flow analysis. However, because of high monthly variability in stream flows and discharge rates for the St. Louis Pond system, this WQA has been developed to consider separate monthly low flows. .

The WQCD’s standard analysis consists of steady-state, mass-balance calculations for most pollutants and modeling for pollutants such as ammonia. The mass-balance equation is used by the WQCD to calculate the maximum allowable concentration of pollutants in the effluent, and accounts for the upstream concentration of a pollutant, critical low flow (minimal dilution), effluent flow, and the water quality standard. The mass-balance equation is expressed as:

$$M_2 = \frac{M_3 Q_3 - M_1 Q_1}{Q_2}$$

where:

Q_1 = Upstream low flow (1E3 or 30E3)
Q_2 = Average daily effluent flow (design capacity)
Q_3 = Downstream flow ($Q_1 + Q_2$)
M_1 = In-stream background (upstream) pollutant concentrations
M_2 = Calculated maximum allowable effluent pollutant concentration (a.k.a, the water quality-based effluent limitation (WQBEL))
M_3 = Maximum allowable in-stream pollutant concentration (water quality standards)

The upstream background pollutant concentrations (M_1) used in the mass-balance equation will vary based on the regulatory definition of existing water quality. For dissolved metals, existing quality is determined to be the 85th percentile. For total and total recoverable metals, existing quality is determined to be the 50th percentile.

Pollutants to be Evaluated

As part of this WQA, cyanide and metals for which there are standards were evaluated. The pollutants evaluated thus included:

- Total recoverable arsenic (As, Trec)
- Dissolved cadmium (Cd, Dis)
- Total recoverable trivalent chromium (Cr^{+3}, Trec)
- Dissolved hexavalent chromium (Cr^{+6}, Dis)
- Dissolved copper (Cu, Dis)
- Free cyanide (CN, Free)
- Total recoverable iron (Fe, Trec)
- Dissolved lead (Pb, Dis)
- Dissolved manganese (Mn, Dis)
- Total mercury (Hg, Tot)
- Dissolved nickel (Ni, Dis)
- Dissolved selenium (Se, Dis)
- Dissolved silver (Ag, Dis)
- Dissolved zinc (Zn, Dis)
- Temperature
- Salinity

During the assessment of the St. Louis Pond System and receiving stream water quality, no additional parameters were identified as pollutants of concern.

St. Louis Tunnel

The St. Louis Tunnel is located in the SE quarter of Section 25, T40N, R11W in Dolores County. The St. Louis Tunnel is located upstream of the confluence with Silver Creek and the Town of Rico. The St. Louis Tunnel discharge is made up of surface water mine drainage emanating from the mountain, which is routed through a series of 11 settling ponds before discharging to the Dolores River. Flow rates for the discharge are dependent upon regional precipitation patterns and natural hydrogeologic processes and are not subject to manipulation. Based on records of historical discharge rates for the pond system, monthly effluent discharge flows ("design flows") were established as follows:

- January –2 cfs
- February – 2 cfs
- March – 2 cfs
- April – 2.5 cfs

- May – 3 cfs
- June – 3.3 cfs
- July – 3.2 cfs
- August – 3 cfs
- September – 3.1 cfs
- October – 2.5 cfs
- November – 2.2 cfs
- December – 2 cfs

Nearby Sources

There are five unpermitted historic sources of metals to the Dolores River in the vicinity of the Town of Rico. These mine-related drainages include:

- The Argentine Seep, which discharges to Silver Creek upstream of the Town of Rico.
- The Columbia Tailings Seep, which discharges to the Dolores River downstream of the confluence with Silver Creek, south of the Town of Rico.
- The Rico Boy Adit, which discharges to a constructed wetland that drains to the Dolores River downstream of the Columbia Tailings Seep.
- The Santa Cruz Adit, which discharges to the same constructed wetland as the Rico Boy Adit.
- The Silver Swan Adit, which discharges to a constructed wetland that drains on an intermittent basis (frequently having no discharge) to the Dolores River downstream of the Rico Boy and Santa Cruz Adits.

These other potential pollutant sources were not included in this determination of the assimilative capacities because of the lack of information about the exact impact of these discharges have on COSJDO03. The flow rates for the other unpermitted discharges are small in comparison to the St. Louis Treatment System discharge and at certain times of the year these other sources do not discharge at all. In addition, the anticipated treatment of the St. Louis Tunnel discharge will result in lower pollutant levels in the stream, further improving the water quality conditions in the Dolores River. Therefore, it was concluded that a mass balance calculation at the St. Louis Treatment system discharge would be protective of the Dolores River until further analysis indicates otherwise.

An assessment of nearby facilities based on EPA's Permit Compliance System (PCS) database found no other permitted discharges on Segment 3 of the Dolores River and only three permitted dischargers in all of Dolores County. These were:

- COG582039, the Town of Dove Creek domestic Wastewater Treatment Plant (WWTP)
- COG582023, Lee, Richard domestic WWTP
- CO0045745, Lucas Property Holdings Gold Mine.

These facilities are located more than twenty miles downstream from the St. Louis Tunnel and thus were not considered relevant to this assessment. There is also a potential new source to consider for a new domestic WWTF (PEL-200178). The Town of Rico is proposing a domestic WWTF that will discharge to the mainstem of the Dolores River just above the confluence of the Dolores River and Sulfur Creek. The affects of this discharge point should not add high metals to the stream because the town's domestic water source is located above the problematic mining areas. Any impacts from the proposed Town of Rico WWTF will need to be evaluated in the future if the WWTF is constructed.

<u>Metals and Cyanide</u>

Metals are pollutants of concern in this assessment. At the request of Atlantic Richfield, monthly assimilative capacities for metals and cyanide were calculated for the St. Louis Treatment System discharge. Monthly assimilative capacities were calculated using the mass-balance equation provided in the beginning of Section IV. The data used in the mass-balance equation are summarized in the following tables:

- Table A-6 summarizes the chronic upstream low flows (Q_1), effluent design flows (Q_2), and combined downstream flows (Q_3) used to calculate the chronic monthly assimilative capacities.
- Table A-7 summarizes the acute upstream low flows (Q_1), effluent design flows (Q_2), and combined downstream flows (Q_3) used to calculate the acute monthly assimilative capacities.
- Table A-8 summarizes the upstream background concentrations (M_1) and the chronic and acute water quality standards (M_3) used to calculate chronic and acute monthly assimilative capacities.

The calculated chronic and acute monthly assimilative capacities shown in Tables A-9 and A-10, respectively, are the monthly maximum levels that could be discharged from the St. Louis Treatment System at the monthly design flows without exceeding water quality standards in Dolores River during low-flow conditions. This procedure is protective of water quality in the Dolores River because it accounts for monthly variation in both the St. Louis Tunnel discharge and the in-stream low flow. The flow rates of both the St. Louis Tunnel discharge and the Dolores River are related to area precipitation, and therefore, it is highly unlikely the St. Louis Treatment System discharge will be at peak rates during low-flow river conditions. Because the St. Louis Tunnel discharge flows are related to precipitation there is the possibility that the "design flows" established for this WQA may be exceeded. If this situation were to occur, the waste load allocations provided in Tables A-11 and A-12 would be applied to the discharge to be protective of the water quality standards.

Table A-6
Flow Calculations for Chronic Assimilative Capacities

Flow Type	*Month*											
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Monthly Low Flow $\mathbf{Q_1}$ (cfs)	6.1	6.1	6.2	23.2	45.4	13.2	8.5	7.9	7.9	10.5	6.1	6.1
Effluent Flow $\mathbf{Q_2}$ (cfs)	2	2	2	2.5	3	3.3	3.2	3	3.1	2.5	2.2	2
Combined Flow $\mathbf{Q_3}$ (cfs)	8.1	8.1	8.2	25.7	48.4	16.5	11.7	10.9	11.0	13.0	8.3	8.1

Table A-7
Flow Calculations for Acute Assimilative Capacities

Flow Type	***Month***											
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Monthly Low Flow $\mathbf{Q_1}$ (cfs)	3.8	5.7	4.9	21.9	45.4	12.5	7.9	5.6	7.9	9.9	5.9	3.2
Effluent Flow $\mathbf{Q_2}$ (cfs)	2	2	2	2.5	3	3.3	3.2	3	3.1	2.5	2.2	2
Combined Flow $\mathbf{Q_3}$ (cfs)	5.8	7.7	6.9	24.4	48.4	15.8	11.1	8.6	11.0	12.4	8.1	5.2

Table A-8
Background and Water Quality Standards for Chronic and Acute Assimilative Capacities

Pollutant	***Background Conc. M_1 (µg/l)***	***Chronic Water Quality Standard M_3 (µg/l)***	***Acute Water Quality Standard M_3 (µg/l)***
As, Trec	0.30	7.6	340
Cd, Dis	0.068	0.84	6
Cr+3, Trec	0	100	NA
Cr+6, Dis	0.12	11	16
Cu, Dis	1.6	19	32
CN, Free	0	NA	5
Fe, Trec	70	1,000	NA
Pb, Dis	0.20	6.6	170
Mn, Dis	32	2229	4035
Hg, Tot	0.0005	0.01	NA
Ni, Dis	0.092	112	1,006
Se, Dis	0.70	4.6	18.4
Ag, Dis	0.032	1.5	9.6
Zn, Dis	20	269	310

Table A-9
Chronic Assimilative Capacities for Metals and Cyanide for the St. Louis Treatment System (µg/l)

Pollutant	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
As, Trec	30	30	30	75	118	37	27	27	26	38	28	30
Cd, Dis	3.2	3.2	3.2	8.0	12.5	3.9	2.9	2.9	2.8	4.1	3.0	3.2
Cr+3, Trec	407	407	411	1,029	1,614	500	367	362	354	521	379	407
Cr+6, Dis	44.4	44.4	44.8	112	176	54.5	40.0	39.5	38.6	56.8	41.4	44.4
Cu, Dis	72.4	72.4	73.0	180	282	88.4	65.3	64.6	63.1	92.2	67.6	72.4
Fe, Trec	3,857	3,857	3,888	9,636	15,084	4,715	3,479	3,438	3,360	4,914	3,598	3,857
Pb, Dis	26.3	26.3	26.5	66.0	104	32.2	23.7	23.4	22.8	33.5	24.5	26.3
Mn, Dis	8,980	8,980	9,050	22,630	35,490	11,000	8,080	7,990	7,800	11,470	8,370	8,980
Hg, Tot	0.039	0.039	0.040	0.098	0.15	0.048	0.035	0.035	0.034	0.050	0.037	0.039

Ni, Dis	460	460	460	1150	1800	560	410	410	400	580	430	460
Se, Dis	16.6	16.6	16.7	40.8	63.7	20.2	15.0	14.8	14.5	21.0	15.5	16.6
Ag, Dis	6.01	6.01	6.06	15.1	23.7	7.37	5.41	5.35	5.23	7.68	5.60	6.01
Zn, Dis	1,030	1,030	1,040	2,580	4,040	1,260	930	920	900	1,320	960	1,030

Table A-10
Acute Assimilative Capacities for Metals and Cyanide for the St. Louis Treatment System (µg/l)

Pollutant	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
As, Trec	992	1,305	1,171	3,312	5,484	1,629	1,175	976	1,202	1,679	1,258	891
Cd, Dis	17.4	22.9	20.5	57.9	95.8	28.5	20.6	17.1	21.1	29.4	22.0	15.6
Cr+6, Dis	46.5	61.1	54.8	155	256	76.2	55.0	45.7	56.3	78.6	58.9	41.8
Cu, Dis	90.3	118	106	298	492	147	107	88.9	109	152	114	81.3
CN, Free	14.6	19.2	17.2	48.7	80.7	24.0	17.3	14.4	17.7	24.7	18.5	13.1
Pb, Dis	496	652	585	1656	2741	814	587	488	601	839	629	446
Mn, Dis	11,720	15,410	13,820	39,060	64,650	19,220	13,870	11,530	14,190	19,820	14,850	10,530
Ni, Dis	2,940	3,860	3,470	9,810	16,240	4,820	3,480	2,890	3,560	4,970	3,730	2,640
Se, Dis	52.4	68.7	61.7	173	286	85.5	61.9	51.5	63.3	88.2	66.2	47.1
Ag, Dis	28.0	36.8	33.0	93.3	155	45.9	33.1	27.5	33.9	47.3	35.5	25.1
Zn, Dis	870	1,130	1,020	2,850	4,700	1,410	1,020	850	1,050	1,450	1,090	780

Table A-11
Chronic Waste Load Allocations for Metals and Cyanide for the St. Louis Treatment System (lbs/d)

Pollutant	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
As, Trec	0.32	0.32	0.33	1.02	1.91	0.65	0.47	0.43	0.44	0.52	0.33	0.32
Cd, Dis	0.035	0.035	0.035	0.108	0.203	0.070	0.050	0.046	0.047	0.055	0.036	0.035
Cr+3, Trec	4.39	4.39	4.43	13.86	26.11	8.88	6.32	5.86	5.91	7.02	4.50	4.39
Cr+6, Dis	0.479	0.479	0.483	1.510	2.842	0.969	0.690	0.639	0.645	0.765	0.491	0.479
Cu, Dis	0.781	0.781	0.787	2.431	4.564	1.573	1.127	1.044	1.054	1.242	0.801	0.781
Fe, Trec	41.6	41.6	41.9	129.8	243.9	83.9	60.0	55.6	56.1	66.2	42.7	41.6
Pb, Dis	0.283	0.283	0.285	0.890	1.674	0.572	0.408	0.378	0.382	0.452	0.290	0.283
Mn, Dis	96.8	96.8	97.6	304.9	573.9	195.7	139.4	129.2	130.4	154.6	99.2	96.8
Hg, Tot	0.00042	0.00042	0.00043	0.0013	0.0025	0.00085	0.00061	0.00056	0.00057	0.00067	0.00043	0.00042
Ni, Dis	4.91	4.91	4.95	15.51	29.22	9.94	7.08	6.56	6.62	7.86	5.03	4.91
Se, Dis	0.179	0.179	0.180	0.550	1.029	0.359	0.259	0.240	0.242	0.283	0.184	0.179
Ag, Dis	0.0648	0.0648	0.0653	0.2040	0.3839	0.1310	0.0934	0.0865	0.0873	0.1035	0.0664	0.0648

Zn, Dis	11.15	11.15	11.24	34.78	65.33	22.48	16.09	14.91	15.05	17.75	11.44	11.15

Table A-12
Acute Waste Load Allocations for Metals and Cyanide for the St. Louis Treatment System (lbs/d)

Pollutant	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
As, Trec	10.7	14.1	12.6	44.6	88.7	29.0	20.3	15.8	20.1	22.6	14.9	9.61
Cd, Dis	0.187	0.246	0.221	0.780	1.550	0.507	0.355	0.277	0.352	0.396	0.261	0.168
Cr+6, Dis	0.501	0.659	0.591	2.088	4.147	1.356	0.949	0.739	0.941	1.059	0.699	0.450
Cu, Dis	0.973	1.276	1.146	4.013	7.958	2.619	1.840	1.437	1.823	2.045	1.353	0.877
CN, Free	0.1573	0.2070	0.1857	0.6569	1.3053	0.4263	0.2982	0.2322	0.2955	0.3330	0.2196	0.1414
Pb, Dis	5.34	7.03	6.31	22.31	44.33	14.48	10.13	7.89	10.04	11.31	7.46	4.80
Mn, Dis	126.3	166.1	149.0	526.3	1045.4	341.8	239.3	186.4	237.1	267.0	176.1	113.5
Ni, Dis	31.7	41.7	37.4	132.2	262.6	85.8	60.0	46.7	59.5	67.0	44.2	28.4
Se, Dis	0.564	0.740	0.665	2.335	4.632	1.521	1.068	0.833	1.058	1.188	0.786	0.508
Ag, Dis	0.301	0.397	0.356	1.257	2.498	0.816	0.571	0.445	0.566	0.638	0.421	0.271
Zn, Dis	9.34	12.22	10.99	38.37	76.03	25.08	17.64	13.79	17.48	19.58	12.97	8.42

Temperature:

The mass-balance equation was used to determine the assimilative capacity for temperature or the Maximum Weekly Effluent Temperature (MWET). The upstream Maximum Weekly Average Temperature (MWAT) for the Dolores River was determined from the limited data that was collected at the upstream sampling location COSJDO03-0.4. At this time, there are only 10 temperature data points, of which, only one was measured during the summer months of June, July, and August. This one value, measured on 8/2/2005, was the maximum of the data set and was used as the MWAT. Additional temperature data will be necessary to more appropriately calculate the MWET. The calculations of the annual 7E3 low flow (4.0 cfs) used the same flow information as that used in calculating the 1E3 and 30E3 low flows.

Using the mass-balance equation provided in the beginning of Section IV, the chronic low flows set out in Section III, the MWAT as discussed above, and the in-stream standards for temperature shown in Section II, assimilative capacity for temperature was calculated. The data used and the resulting calculations of the allowable discharge temperature are set forth below.

Table A-13
Water Quality Based Effluent Limits for Temperature (Degrees C)

Parameter	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*MWAT*	*Standard*	*MWET*
Temperature	**4.0**	**3.3**	**7.3**	**13.8**	**20**	**27.5**

Salinity:

To protect against salinity levels becoming too high in the Colorado River, Regulation No. 61

states for industrial sources “the no-salt discharge requirement, and the requisite demonstration that it is not practicable to prevent the discharge of all salt, may be waived in those cases where the salt load reaching the mainstem of the Colorado River is less than one ton per day or 350 tons per year, whichever is more appropriate. The Division may permit the discharge of salt upon a satisfactory demonstration by the permittee that it is not practicable to prevent the discharge of salt.” Since much of the effluent is intercepted groundwater that may reach the stream anyway, a monitoring only requirement for TDS may be justified, solely to establish what the salt loading is to the stream.

There is also a possibility that limitations for EC_w and Sodium Adsorption Ratio (SAR) might be applied as according to Water Quality Control Division Policy 24. However, the limited Na effluent data indicate a low Na concentration. The low Na level along with the available Ca and Mg data indicate that the SAR of the effluent is low. The TDS level is also not exceedingly high, indicating that the EC_w is also probably low. Because of the limited data, it is recommended that monitoring of the effluent be continued for these parameters to justify these conclusions.

V. Antidegradation Review

As set out in *The Basic Standards and Methodologies for Surface Water*, Section 31.8(2)(b), an antidegradation analysis is required where new or increased water quality impacts occur to undesignated, or “reviewable” waterbodies. According to the *Classifications and Numeric Standards for San Juan and Dolores River Basins*, stream segment COSJDO03 is “reviewable.” Thus, an antidegradation review is required for this segment if new or increased impacts are found to occur.

The WQCD’s Antidegradation Significance Determination for New or Increased Water Quality Impacts Procedural Guidance, Version 1.0, updated April 2002 (hereinafter referred to as the WQCD’s Antidegradation Guidance), provides guidance on the determination of new or increased water quality impacts or significant degradation. Because the Dolores River is undesignated, an antidegradation review is required to determine if any new or increased impacts will result in significant degradation. Once an impact is identified, the impact must be evaluated for significance. There are four tests for the absence of significant degradation as outlined in Section 31.8 (3)(c):

- For bioaccumulative toxic pollutants such as mercury, the new or increased loading from the source under review is less than 10 percent of the existing total load to that portion of the segment impacted.
- For all other pollutants
  - The flow rate of the discharge is small enough that it will be diluted by at least 100:1 at low flow by water in the stream; or
  - Only a temporary change in water quality will result; or
  - The new effluent concentration will not cause an increase of more than 15 percent of the available increment over the base line.

These tests must be evaluated for each pollutant of concern. Because this assessment relates to the issuance of a CDPS permit, which will be effective for a period of 5 years, the impact is not considered temporary or short-term. Also, the dilution ratio of chronic low flow to design flow is not greater than 100:1 for this discharge. Therefore, the concentration test must be conducted to determine the discharge levels that would result in insignificant degradation for each pollutant of concern. An antidegradation review would not be necessary for a pollutant if there is a determination of no new or increased water quality impact for that pollutant.

Consistent with current WQCD procedures, the Baseline Water Quality (BWQ) concentrations for pollutants of concern should be established so that it can be used as part of the antidegradation review. BWQ is defined by the WQCD as the condition of the water quality as of September 30, 2000. Furthermore, the WQCD specifies that BWQ will include the influence of the discharger if it was in place on September 30, 2000. Accordingly, BWQ concentrations are determined by assessment of downstream water quality at a location reflecting fully mixed conditions. This site is the COSJDO03-1.4 sampling location downstream of the pond system outfall. The BWQ for the parameters of concern are listed below in Table A-14.

Table A-14
Baseline Water Quality Concentrations for the Dolores River below the St. Louis Pond System

Pollutant	*BWQ (µg/l)*	*WQS (µg/l)*
As, Trec	0.4	7.6
Cd, Dis	***0.85***	0.84
Cr+6, Dis	0.05	11
Cr+3, Trec	0.54	100
Cu, Dis	1.24	19
CN, Free	0	5
Fe, Trec	250	1000
Pb, Dis	0.25	6.6
Mn, Dis	419	2229
Ni, Dis	0	112
Se, Dis	0.92	4.6
Ag, Dis	0	1.5
Zn, Dis	165	269

Note:
Bold and italic numbers indicate the BWQ exceed the WQS.

In order to establish the BWQ condition, the WQCD evaluates five years of ambient, downstream water quality data, if available, for the five years prior to September 30, 2000. Due to very limited data (four or less data points) available during the timeframe of September 30, 1995 through September 30, 2000, the overall period of record used to determine the BWQ is April 1998 through January 2006. The justification for using data later than September 30, 2000 is that there have been no water quality changes to the watershed nor have there been any changes to the discharge since before September 30, 2000. Using the period of record of April 1998 through January 2006, provided 14 additional data points and results in a more accurate analysis of the BWQ.

The pollutant concentrations used as the BWQ vary based on the regulatory definition of existing ambient water quality. For most pollutants, including dissolved metals; existing quality is characterized by the 85th percentile. For metals in the total and total recoverable form, existing quality is characterized by the 50th percentile.

Note that when the calculated BWQ concentration exceeds the water quality standard there is no baseline available increment to protect. According to the WQCD Antidegradation Guidance, the antidegradation-based average concentration (ADBAC) cannot be calculated and antidegradation-based limits would not apply because the water quality is already degraded based on the BWQ. For dissolved cadmium, the BWQ exceeds the water quality standards, therefore antidegradation-based limits do not apply.

After BWQ concentrations have been determined for potential pollutants of concern, the antidegradation analysis continues for those pollutants showing new or increased impacts on the receiving stream. New or increased impacts are expected to result from this permit issuance because for some pollutants the calculated WQBELs are greater than previous limits. Because there is not a current permit for the St. Louis Tunnel discharge and thus no current permit limits, the regulations provide for determination of implicit limits based on historic discharges. Table A-15 summarizes the effluent discharge data from the St. Louis Pond System that was used to determine the implicit limits (data shown in column titled “Maximum” of Table A-15). The effluent discharge data are for a period of record of October 1999 through January 2006. This period of record was used to maximize the number of samples in the data set. As noted previously, there have not been any changes to the effluent that would impact the discharge water quality during this time period. A comparison of the implicit limits with the calculated WQBELs indicates there is an increased impact for all pollutants except dissolved cadmium and dissolved zinc. Thus, the antidegradation review procedure must continue for all other parameters to determine if the impacts are significant.

The ADBAC limit is a two-year rolling average limit, which means that while an ADBAC limit will remain the same throughout the life of a permit, the permittee will determine compliance each month with the ADBAC limit by averaging the two previous years of data.

ADBACs are calculated using the significant concentration threshold (SCT), which is the additional amount of pollutant above the BWQ that would not cause significant degradation. The baseline available increment (BAI) is the remaining assimilative capacity of the receiving stream below the discharge and is calculated as the water quality standard (WQS) minus the baseline water quality (BWQ). The SCT for most pollutants equals the BWQ plus 15 percent of the remaining assimilative capacity (15% of BAI), and is calculated by the following equation:

$$SCT = 0.15 \times (WQS - BWQ) + BWQ$$

The antidegradation requirements outlined in *Regulation 31.0Basic Standards and Methodologies for Surface Water* specify that chronic numeric standards and chronic low flows (30E3) be used; however, where there is only an acute standard, the acute standard and low flow (1E3) should be used. Chronic standards were available for all pollutants except cyanide. ADBACs are then determined by re-calculating the mass-balance equation using the SCT in place of the water quality standard, as in the following equation:

$$ADBAC = \frac{SCT \times Q_3 - M_1 Q_1}{Q_2}$$

where: Q_1 = Upstream low flow (1E3 or 30E3)
Q_2 = Average daily effluent flow (design capacity)
Q_3 = Downstream flow (Q_1 + Q_2)
M_1 = Ambient existing water quality concentration (From Section II)
SCT = Significant concentration threshold

The SCTs and ADBACs for pollutants of concern are provided in Table A-16.

Table A-15
Effluent Discharge Data for the St. Louis Pond System (µg/l)

Parameter	*Number of Samples*	*15th Percentile*	*50th Percentile*	*85th Percentile*	*Mean*	*Maximum*	*Notes*
As, Trec	4	0	0	0	0	0	
Cd, Dis	19	5.51	10	15.4	14.9	80.1	
Cr+3, Trec	15	0	0	0.19	0.153	1.6	
Cr+6, Dis	4	0	0	0	0	0	
Cu, Dis	19	0	3	8.17	3.24	15.7	
CN, Free	6	0	0	0	0	0	
Fe, Trec	20	302	500	1176	696	1410	
Pb, Dis	19	0	0	0.55	0.219	1.22	
Mn, Dis	19	955	1720	2128	1733	4210	
Hg, Tot	11	0	0	0.0003	0.0001	0.0004	1
Ni, Dis	14	0	0	0.5	1.43	10	
Se, Dis	13	0	0	0.58	0.284	1.39	
Ag, Dis	19	0	0	0.06	0.0268	0.27	
Zn, Dis	19	1320	2090	3098	2940	13,500	

Note 1: Four of the eleven total mercury samples are suspect due to contamination in the field blanks. These data could be voided in accordance with Method 1631. If data were to be voided, it would result in the seven remaining samples all being below the detection level. See discussion on total mercury in Section II. Water Quality.

Table A-16
SCTs and ADBACs for the St. Louis Treatment System

Pollutant	*BAI (µg/l)*	*SCT (µg/l)*	*M_1 (µg/l)*	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*ADBAC*
As, Trec	7.2	1.5	0.3	6.1	3.3	9.4	3.7
Cd, Dis	No BAI	No SCT	0.067	6.1	3.3	9.4	NA
Cr+6, Dis	11	1.69	0.12	6.1	3.3	9.4	4.6
Cr+3, Trec	99	15.5	0	6.1	3.3	9.4	44
Cu, Dis	17.8	3.9	1.62	6.1	3.3	9.4	8.1
CN, Free	5.0	0.750	0	3.2	3.3	6.5	1.5
Fe, Trec	750	363	70	6.1	3.3	9.4	903
Pb, Dis	6.4	1.2	0.20	6.1	3.3	9.4	3.0

Table A-16 SCTs and ADBACs for the St. Louis Treatment System							
Pollutant	***BAI (µg/l)***	***SCT (µg/l)***	***M_1 (µg/l)***	***Q_1 (cfs)***	***Q_2 (cfs)***	***Q_3 (cfs)***	***ADBAC***
Mn, Dis	1810	691	32.5	6.1	3.3	9.4	1908
Ni, Dis	112	16.8	0.092	6.1	3.3	9.4	48
Se, Dis	3.68	1.47	0.70	6.1	3.3	9.4	2.9
Ag, Dis	1.5	0.225	0.0315	6.1	3.3	9.4	0.58
Zn, Dis	105	180	20	6.1	3.3	9.4	476
Notes: - Cadmium BWQ exceeds the WQS so there is no BAI and thus the SCT and ADBAC cannot be calculated. - Q_2 is based on the maximum of the monthly design flows.							

In lieu of being subject to the ADBACs, facilities have the option of retaining their permit limits based on their current authorized load if those loads are protective of water quality standards. By agreeing to retain Non-Impact Limits (NIL) based on their current authorized load, new or increased impacts will not occur and thus ADBACs will not be considered in the permit. NILs are concentration limits based on the current permitted load and the proposed design flow.

For those pollutants for which permit limits have not yet been established, an implicit load allocation is determined and an implicit NIL is established. An implicit load allocation is based on the implicit limit (maximum concentration of the effluent in the previous 2 years of data) and the existing design flow. The implicit NIL is based on the implicit load allocation and the proposed design flow. However, the implicit NIL cannot be greater in concentration than the implicit limit.

Although there is currently no effective permit for the St. Louis Tunnel, the previous permit contained limits for cadmium, copper, lead, silver, and zinc. The limits for these pollutants were based on the total recoverable forms, whereas the current water quality standards are based on the dissolved forms. Therefore, since no applicable prior effluent limits exist, implicit limits were established for both previously permitted pollutants and pollutants that were not previously permitted based on the maximum historic effluent concentrations. The period of record used for determining the implicit NILs is the same as that used in the antidegradation review. According to the WQCD Antidegradation Guidance the most recent 2-year period is to be used. However, some pollutants have limited data for this period and because this is an untreated mine drainage there have been no actions that would have resulted in changes in effluent quality during the April 1998 through January 2006 timeframe.

The existing design flow used to calculate the implicit load allocation is the previously permitted discharge for the St. Louis Ponds of 4.0 cfs. The previously permitted discharge flow is higher than the proposed monthly design flows that were based on an evaluation of recorded historic discharge flows. This results in the calculated implicit NILs being higher in concentration than the implicit limits. As stated above, the implicit NIL cannot be greater in concentration than the implicit limit. Therefore, the implicit limits (or maximum concentration of the data) were used as the implicit NIL.
The implicit permitted load, the new WQBELs load, and the NIL were calculated using the following equations:

Implicit permitted load = $M_{permitted} \times Q_{permitted} \times 8.34$
New WQBELs load = $M_2 \times Q_2 \times 8.34$
NIL = $M_{permitted}$

where,

$M_{permitted}$ = Current permit limit or implicit permit limit (mg/l)
$Q_{permitted}$ = Design flow used in the current permit (MGD)
M_2 = Maximum allowable discharge concentration (WQBEL in mg/l)
Q_2 = Average daily effluent flow (design capacity in MGD)

When selecting the M_2, where both chronic and acute allowable discharge concentrations have been calculated, the most stringent was used.

For all pollutants evaluated, a summary of the implicit limits, the implicit permitted load, the new WQBELs, the new WQBEL load, ADBACs, and NILs are compared in Tables A-17.

Table A-17

WQBELs, ADBACs, and Non-Impact Limits Summary

Pollutant	*Implicit Limit (μg/l)*	*Implicit Load (lb/day)*	*$WQBEL_{new}$[1] (μg/l)*	*$Load_{new}$[1] (lb/day)*	*ADBAC (μg/l)*	*NIL (μg/l)*
As, Trec	0	0	21	0.38	3.7	0
Cd, Dis	80.1	0.855	2.3	0.04	NA[2]	80.1
Cr+6, Dis	0	0	31.1	0.55	4.6	0
Cr+3, TR	1.6	0.0171	285	5.07	44	1.6
Cu, Dis	15.7	0.168	51.1	0.91	8.1	15.7
CN, Free	0	0	9.8	0.18	1.5	0
Fe, Trec	1410	15	2719	48.36	903	1410
Pb, Dis	1.22	0.013	18.4	0.33	3.0	1.22
Mn, Dis	4210	44.9	6289	111.87	1908	4210
Ni, Dis	10	0.107	319	5.67	48	10
Se, Dis	1.39	0.0148	11.8	0.21	2.9	1.39
Ag, Dis	0.270	0.00288	4.2	0.07	0.58	0.27
Zn, Dis	13500	144	729	12.97	476	13500

Notes:
(1) For comparison purposes, WQBELs based on the annual low flow and the maximum design capacity were used and the new loads were calculated using the new WQBELs and the maximum of the monthly design flows.
(2) The ADBAC for Cadmium is not applicable (NA) because the BWQ exceeded the WQS so there is no BAI and thus the SCT and ADBAC cannot be calculated.

As noted in Table A-15, ADBACs and NILs are not applicable when the new WQBEL load is less than the implicit permitted load, or when the new WQBELs are less than the ADBACs. For cadmium and zinc the implicit load is greater than the new load, therefore, the ADBACs and NILs do not apply. For the pollutants for which ADBACs and NILs apply, if the facility chooses the NIL as the proposed 30-day average permit limit, ADBACs will not be applied. Additionally, the facility may complete an alternatives analysis, which could also result in ADBACs not being applied. These options can be further explored with the WQCD.

Antidegradation limits for total mercury were not calculated at this time due to the sample contamination issues associated with the low-level analytical methodology as discussed in Section II Water Quality. At this time, additional monitoring is needed to evaluate the contamination issues and to ascertain accurate levels of total mercury upstream of the discharge.

VI. References

Classifications and Numeric Standards for San Juan and Dolores River Basins, Regulation No. 34, CDPHE, WQCC, Effective July 1, 2007.

The Basic Standards and Methodologies for Surface Water, Regulation 31, CDPHE, WQCC, Effective May 31, 2008.

Antidegradation Significance Determination for New or Increased Discharges, Procedural Guidance, Version 1.0, CDPHE, WQCD, December, 2001.

Colorado Mixing Zone Implementation Guidance, CDPHE, WQCD, April 2002.

Colorado River Salinity Standards, *Regulation 39*, CDPHE, WQCC (last update effective 8/30/97)

Policy for Conducting Assessments for Implementation of Temperature Standards in Discharge Permits, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-23, effective July 3, 2008.

Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-24, effective March 10, 2008.

Summary of Surface Water and Groundwater Data for Rico, Colorado, PTI Environmental Services, November 1995.

Rico Site Remediation Project, Surface Water Monitoring Program, Post-VCUP Interim Report, ESA Consultants, Inc., October 1997.

Upper Dolores River and Silver Creek Basin Water Quality and Discharge Monitoring Summary, ESA Consultants, Inc., December, 1999.

Upper Dolores River and Silver Creek Basin Water Quality and Discharge Monitoring Summary, ESA Consultants, Inc., September 18, 2000.

Emergency Response Trip Report, Rico Town Pond Site, USEPA Region VIII Superfund Technical Assessment and Response Team, Contract No. 68-W5-0031, TDD No. 0004-0010, May 5, 2000.

Emergency Response Trip Report, Rico Town Pond Site, USEPA Region VIII Superfund Technical Assessment and Response Team, Contract No. 68-W5-0031, TDD No. 9511-0015, June 19, 1996.

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 16

Mixing Zone Analysis

Technical Memorandum
on
Mixing Zone Evaluation
for the
St. Louis Ponds Discharge
Rico, Colorado
July 1, 2008

1.0 Introduction

1.1 Mixing Zone Requirements

Regulatory requirements for discharge permits including Water Quality Based Effluent Limits (WQBELs) and whole effluent testing (WET) recognize that effluent discharged to surface waters in most cases do not mix fully with the receiving water at the point of discharge. Accordingly, procedures have been established to evaluate the degree of mixing and the allowable dilution to be used in the permit. These procedures are documented in the Colorado Mixing Zone Implementation Guidance (Guidance Document) (CDPHE, 2002). Generally, the permit is not affected by the Mixing Zone and no additional restrictions or adjustments to WQBELs are applied in the permit if a determination of adequate mixing (or exclusion) is made.

1.2 Summary and Conclusions

Investigations were completed for mixing zone analysis for the discharge from the St. Louis Ponds (Pond System) to the Dolores River in accordance with the CDPHE mixing zone Guidance Document. These investigations included in-stream flow measurements at low flow and concurrent transects of the Dolores River below the discharge. Analysis of those measurements yields the conclusion that the Pond System discharge qualifies for exemption from mixing zone restrictions based on exclusion tables in the Guidance Document. This Technical Memorandum presents the investigations and analysis to support this conclusion. The location of the Pond System discharge and relevant transect and flow-measurement stations discussed below are shown on Figure 1.

2.0 Evaluation Criteria

2.1 Evaluation Approach

The Guidance Document includes a series of up to six sequential steps that are to be evaluated for development of permit limits that are consistent with the mixing zone regulations. Those steps are intended to proceed from the simplest evaluation to the more complex and to be completed only to the extent necessary to determine mixing zone requirements/conditions. For the discharge from the Pond System, it was necessary to complete only the first two of those steps. Those two steps are: (1) application of the exclusion rule for extreme mixing ratios, and (2) application of exclusion tables.

Analysis is to be completed for chronic exposures based on low-flow conditions. No specific analysis of acute low flow is necessary because the size of the mixing zone for acute exposure is taken as a percentage of the chronic mixing zone.

2.2 Exclusion for Extreme Mixing Ratios

Exclusion from Mixing Zone restrictions for this criterion is based on conditions where either the effluent or the receiving water is strongly dominant in volume at the point of discharge. The two conditions are: (1) the effluent is more than twice the flow rate of the receiving stream at chronic low flow or (2) the receiving stream flow rate is more than twenty times the effluent rate at chronic low flow conditions. The Pond System discharge does not qualify for either of these two exclusion conditions as documented in Section 3.2 below.

2.3 Application of Exclusion Tables

The CDPHE has developed conservative tables based on physical principles of mixing that are applied to conditions in the receiving stream at and below the point of discharge to establish if adequate mixing is provided. Application of the tables requires obtaining site-specific information regarding the channel width and mean depth at low-flow conditions. These data include six sets of measurements taken at equally spaced intervals of one bankfull width beginning at the point of discharge and extending downstream. The bankfull width is normally taken as 2 times the low-flow width. For use of the exclusion tables, field measurements can be taken at any flow within the lowest 15th percentile of flows. Mean depth values under low-flow conditions are determined from equidistant measurements of depth over the stream cross-section(s) at a number of points (≥12 for large streams, 6-12 for streams of intermediate size, and 4-6 for small streams) at each of the six transects. For streams with divided channels, mean width and depth are taken from the channel division into which effluent is discharged. The exclusion tables (contained in Appendix I of the Guidance Document) include three separate tables depending on stream gradient. For the Dolores River at the Pond System, the high gradient (montane streams; slope >0.005) table is appropriate. This table, which is provided in Appendix A-1, includes rows of “Width” and columns of “Depth” for which a letter “Y” indicates exclusion of the site from further site-specific analysis of the mixing zone (and that the permit is to be prepared on the basis of full chronic and acute low flows for calculation of WQBELs); whereas, an “N” would indicate the requirement for further evaluation. As will be shown subsequently the discharge at the Pond System meets the requirements for exclusion under this criterion.

3.0 Evaluation

3.1 Calculation of Low-Flow Conditions

Chronic Low Flow. The chronic low-flow rate for consideration of exclusion at extreme mixing ratios has not yet been agreed to with the CDPHE. However, as a preliminary review of the criterion, assumptions were made to provide a basis for consideration of the extreme ratios exclusion. The period of evaluation for determination of chronic flows was selected as 10 years, from 10/1/93 through 9/30/05. Although this time period is greater than 10 years, it was necessary to extend the duration to accommodate periods of missing data. The CDPHE DFLOW computer model was run on gage flow data from DR-G, the USGS gaging station below the Town of Rico, and the output was adjusted to the location of the transects below the Pond System discharge. Flows at DR-G were adjusted based on its flow relationships to that at DR-7 (location on Dolores River directly below Pond System discharge) and DR-1 above the discharge. The resulting chronic low flow calculated above the Pond System discharge is 6.1 cfs.

15th Percentile Flow. Calculation of the 15th percentile flow at the location where transects were taken (below the Pond System discharge) was made by determining the 15th percentile flow for the USGS gaging station below Rico and then adjusting that flow to the vicinity of the Pond System by previously determined flow relationships. The 15th percentile flow at the USGS gaging station, as calculated for the fifty-year period of record from 10/01/1951 thorough 12/31/2004, was determined to be 17.0 cfs. This flow was then adjusted to the site by use of equations derived by SEH during the Water Quality Assessment effort (St. Louis Tunnel WQA, 2008). Those equations include area proration, linear regression, and log-log regression. The average flow so determined for the location above the discharge (DR-1) was adjusted by adding the flow being discharged from the Pond System at the time of taking the transects. This combined flow (from DR-1 and the Pond System discharge) and that calculated by its flow relationship to DR-G for the sampling site below the Pond System discharge (DR-7) were averaged to determine the 15th percentile flow at the location where transects were taken. The 15th percentile flow calculated on this basis for the transect location is 13.4 cfs.

3.2 Extreme Mixing Ratios

The following table summarizes the calculated ratios for dilution with the receiving stream and the conclusion that the extreme ratios criterion for exclusion is not met.

REVIEW OF EXCLUSION CRITERION FOR EXTREME RATIOS

Design flow during low-flow period:	2.0		
Estimated Chronic low-flow:	6.1	Ratio Required for Exclusion	Meet Exclusion Criteria Y/N ?
Ratio of Design Flow to Receiving Stream:	0.33	>2.0	N
Ratio of Receiving Stream To Design Flow:	3.1	>20:1	N

3.3 Field Investigations

15th Percentile Timing. Real-time data at the USGS gaging station were monitored on a daily basis in order to identify a period when the river flow would likely be at or below the 15th percentile. A first such potential opportunity occurred on 11/08/2005; however, when flow measurements were calculated for the location where transects were taken, the flow was found to be 22 cfs, which exceeded the allowable flow of 13.4 cfs. Another opportunity was identified on 11/16/2005 at which time in-stream flow measurements were found to be acceptable. Real-time data from the USGS gaging station for that day also indicated flows within the 15th percentile for the gaging station.

Flow Measurements. On November 16, 2005, to verify that river flow was in the lower 15th percentile, in-stream flow measurements were made at three of the six transect locations and at DR-2 located immediately above the Pond System discharge. Note that the flow from the Pond System discharge at the time transects were taken (1.4 cfs) was added to the flow at DR-2 located directly above both the discharge and the transects. The flow measurements are summarized in the following table:

Summary of Flow Measurements at Time of Transects

Transect T-1	11.3	10:56 AM
Transect T-2	13.6	11:15 AM
Transect T-6	15.2	11:59 AM
DR-2 + Discharge	11.4	12:17 PM
Average Flow (cfs)	**12.9**	

The 12.9 cfs flow at the transect locations during the time they were taken was within the lower 15th percentile calculated as 13.5 cfs in Section 3.1. Provisional flow measurements for DR-G were 12.7 cfs for 11/15/2005 and 16.0 cfs for 11/16/2005. During the time the in-stream measurements were being made, the field personnel noted ice flowing in the stream. It was inferred that the variations in flows between transects as shown in the table above were likely related to ice jams and the accompanying rapid fluctuations in flow. Subsequent to 11/17/2005, the USGS replaced the readings for 11/16/2005 with "ice" with the last official data for the year being recorded for the day prior to taking transects. Fortunately, the in-stream measurements were sufficient to demonstrate that the flow at the time of taking transects was within the lower 15th percentile. Flow measurement data are provided in tabular form in Appendix A-2.

Transects. In accordance with the Guidance Document, a series of six transects were taken, with the first at the location of the discharge, and each subsequent transect located approximately one bank-full width of 60 feet downstream of the previous transect. The location of each transect was documented by GPS and is shown on Figure 1. Bank-full widths as measured at each of the six transect locations are shown below:

Bank-Full Widths as Measured in Field

Transect ID	Bank-Full Width (ft)
T-1	56
T-2	66
T-3	61
T-4	60.5
T-5	46
T-6	54
Average	57

Photographs of each transect were taken and are provided as Appendix A-3. For the record, it should be noted that the time stamp on the camera was in error and that the actual time photographs were taken was approximately 45 minutes earlier than indicated on the photos.

3.4 Mixing Zone Analysis and Results

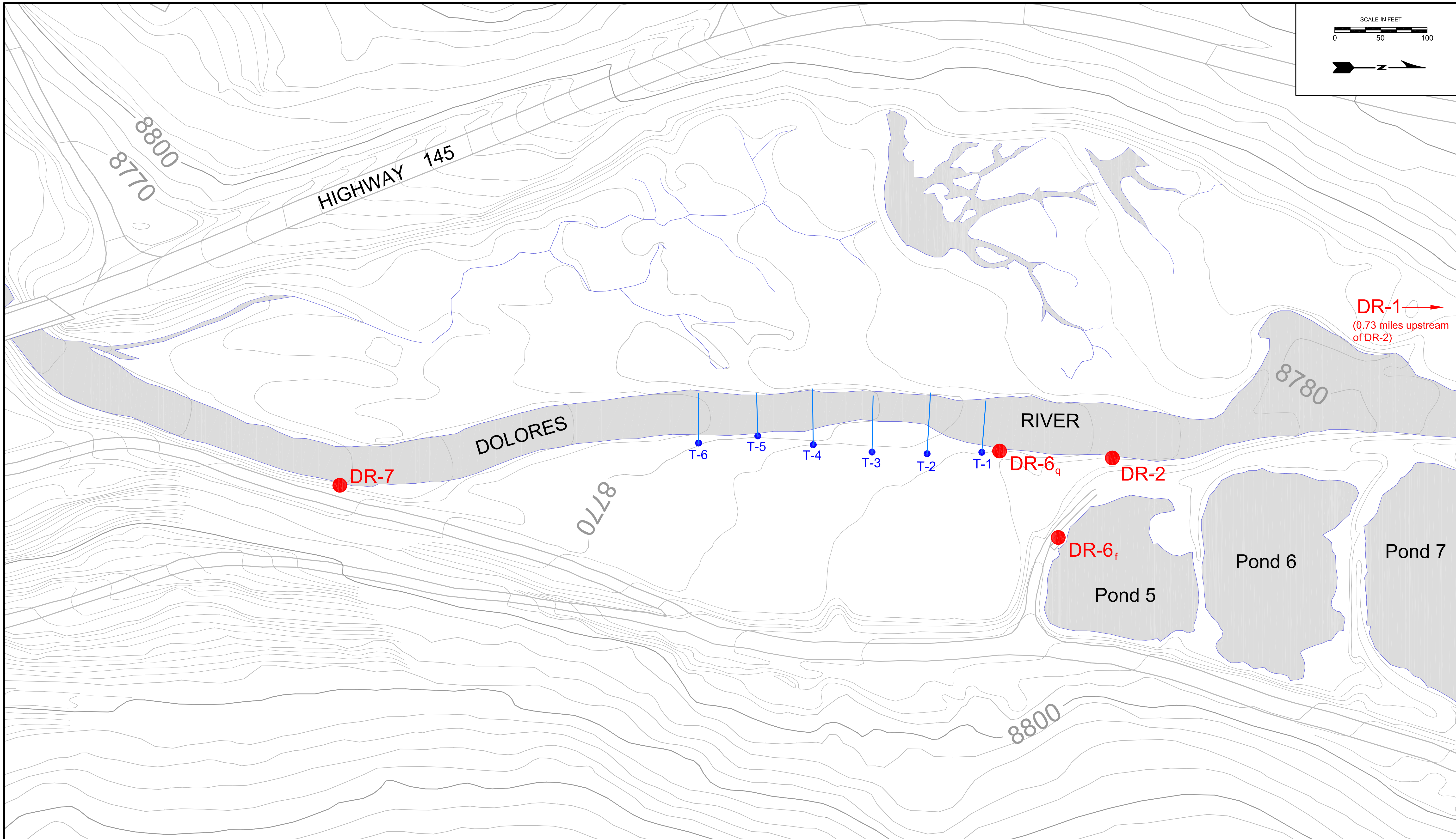
Transect measurements consisted of flow depth and distance from edge of low flow channel at equal spacing of 1.0 ft, 1.5 ft or 2.0 ft depending on the width of the transect. An average of twenty measurements were made for each transect, which provides more refined data than the minimum of 12 measurements required for large streams by the Guidance Document. Transect T-1, which is the one located immediately below the Pond System discharge, was treated as a divided channel since the Pond System discharge enters from one side and an island of rocks prevents its passage through the opposite side of the stream. Generally, where zero depth was measured due to the location of a rock or boulder, that representative portion of the stream was excluded (subtracted) from the analysis. Transect data for each section are provided in Appendix A-4. Following is a summary of the Mixing Zone Exclusion Table Results:

Summary of Transect Results

Completed 11/16/2005

Time	Transect ID	Width (ft)	Depth (ft)	Meet exclusion table Y, N	No of Shots per Transect
10:56 AM	T-1	22.0	0.31	Y	12
11:15 AM	T-2	14.8	0.65	Y	16
11:27 AM	T-3	22.9	0.53	Y	24
11:37 AM	T-4	24.0	0.71	Y	25
11:48 AM	T-5	23.4	0.60	Y	25
11:59 AM	T-6	26.7	0.54	Y	20
	Average	**22.3**	**0.56**	**Y**	**20**

As shown in the preceding table, the conclusion from the evaluation based on each individual transect and the average of all six transects is that the discharge qualifies for exclusion based on the Exclusion Table.



DR-6_f	Location of flow measurements
DR-6_q	Location of water quality measurements and discharge to Dolore River

032DARCOE.DWG

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SEH

MIXING ZONE EVALUATION
ST. LOUIS PONDS DISCHARGE
TRANSECT LOCATIONS

PROJECT: AARCOE0105.00 | DATE: 2/13/06 | FIGURE: 1

Appendix A-1

Exclusion Table for Montane Streams

	Depth, ft										
Width, ft	0.5	0.75	1	1.25	1.5	1.75	2	2.5	3	3.5	4
4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
14	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
18	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
22	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
26	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
30	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
35	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
40	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
50	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
60	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
70	N	N	N	N	Y	Y	Y	Y	Y	Y	Y
80	N	N	N	N	N	Y	Y	Y	Y	Y	Y
90	N	N	N	N	N	N	Y	Y	Y	Y	Y
100	N	N	N	N	N	N	N	Y	Y	Y	Y
120	N	N	N	N	N	N	N	N	Y	Y	Y

Table I-2. Exclusion table for montane streams.

Appendix A-2

Flow Measurement Data

Flow Calculation at Transect DR-2

Shot Number	Distance (ft)	Segment Width (ft)	Depth (ft) at shot number	Average Segment Depth	velocity measure-ment #1 (ft/sec)	velocity measure-ment #2 (ft/sec)	velocity measure-ment #3 (ft/sec)	Average velocity of #1-3 (ft/sec)	Segment Flow Velocity (ft/sec)	Segment Flow (cfs)	
1	23.9		0.00		0.00	0.00	0.00	0.00			edge of bank
2	24.0	0.1	0.10	0.05	0.12	0.28	0.36	0.25	0.13	0.00	
3	26.0	2.0	0.50	0.30	0.25	0.17	0.14	0.19	0.22	0.13	
4	28.0	2.0	0.95	0.73	0.72	0.66	0.67	0.68	0.44	0.63	
5	30.0	2.0	0.95	0.95	0.27	0.25	0.24	0.25	0.47	0.89	
6	32.0	2.0	1.00	0.98	0.03	0.05	0.08	0.05	0.15	0.30	
7	34.0	2.0	0.90	0.95	1.10	1.56	1.23	1.30	0.68	1.28	
8	36.0	2.0	1.20	1.05	0.25	0.09	0.07	0.14	0.72	1.51	
9	38.0	2.0	1.20	1.20	0.61	0.60	0.82	0.68	0.41	0.98	
10	40.0	2.0	1.10	1.15	0.94	1.03	0.86	0.94	0.81	1.86	
11	42.0	2.0	1.20	1.15	0.36	0.17	0.16	0.23	0.59	1.35	
12	44.0	2.0	0.95	1.08	0.19	0.08	0.06	0.11	0.17	0.37	
13	46.0	2.0	0.45	0.70	0.45	0.48	0.27	0.40	0.26	0.36	
14	47.9	1.9	0.00	0.23	0.00	0.00	0.00	0.00	0.20	0.09	edge of bank

Total Flow (cfs): 9.74
Total Flow (gpm) 4370

Flow at DR-2 above pond discharge:	9.74
Flow from pond discharge at time of Transects:	1.4
Flow through reach of Transects	11.14

Flow Calculation at Transect T-1

Shot Number	Distance (ft)	Segment Width (ft)	Depth (ft) at shot number	Average Segment Depth	velocity measure-ment #1 (ft/sec)	velocity measure-ment #2 (ft/sec)	velocity measure-ment #3 (ft/sec)	Average velocity of #1-3 (ft/sec)	Segment Flow Velocity (ft/sec)	Segment Flow (cfs)	
1	3.9		0.00		0.00	0.00	0.00	0.00			edge of bank
2	4.0	0.1	0.20	0.10	0.74	0.53	0.85	0.71	0.35	0.00	
3	6.0	2.0	0.45	0.33	0.79	1.07	0.75	0.87	0.79	0.51	
4	8.0	2.0	0.45	0.45	0.71	0.92	1.09	0.91	0.89	0.80	
5	10.0	2.0	0.25	0.35	-0.11	-0.14	-0.19	-0.15	0.38	0.27	
6	12.0	2.0	0.40	0.33	0.21	0.26	0.25	0.24	0.05	0.03	
7	14.0	2.0	0.00	0.20	0.00	0.00	0.00	0.00	0.12	0.05	
8	16.0	2.0	0.10	0.05	1.40	1.39	1.29	1.36	0.68	0.07	
9	18.0	2.0	0.00	0.05	0.00	0.00	0.00	0.00	0.68	0.07	
10	20.0	2.0	0.35	0.18	1.60	1.69	1.58	1.62	0.81	0.28	
11	22.0	2.0	0.00	0.18	0.00	0.00	0.00	0.00	0.81	0.28	
12	24.0	2.0	0.10	0.05	0.76	0.81	0.51	0.69	0.35	0.03	
13	26.0	2.0	0.20	0.15	0.18	-0.07	-0.02	0.03	0.36	0.11	
14	28.0	2.0	0.00	0.10	0.00	0.00	0.00	0.00	0.02	0.00	
15	30.0	2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
16	32.0	2.0	0.25	0.13	1.45	1.54	1.53	1.51	0.75	0.19	
17	34.0	2.0	0.50	0.38	1.14	1.07	1.15	1.12	1.31	0.99	
18	36.0	2.0	0.50	0.50	0.15	0.10	0.17	0.14	0.63	0.63	
19	38.0	2.0	0.10	0.30	0.23	0.23	0.35	0.27	0.21	0.12	
20	40.0	2.0	0.10	0.10	0.65	0.52	0.55	0.57	0.42	0.08	
21	42.0	2.0	0.20	0.15	0.50	0.56	0.66	0.57	0.57	0.17	
22	44.0	2.0	0.20	0.20	1.39	1.38	1.46	1.41	0.99	0.40	
23	46.0	2.0	0.45	0.33	2.16	2.16	2.03	2.12	1.76	1.15	
24	48.0	2.0	0.60	0.53	2.00	1.79	1.82	1.87	1.99	2.09	
25	50.0	2.0	0.70	0.65	1.15	1.79	1.82	1.59	1.73	2.25	
26	52.0	2.0	0.15	0.43	0.26	0.12	0.12	0.17	0.88	0.75	
27	54.0	2.0	0.00	0.08	0.00	0.00	0.00	0.00	0.08	0.01	edge of bank

Total Flow (cfs): 11.33
Total Flow (gpm) 5086

Flow Calculation at Transect T-2

Shot Number	Distance (ft)	Segment Width (ft)	Depth (ft) at shot number	Average Segment Depth	velocity measure-ment #1 (ft/sec)	velocity measure-ment #2 (ft/sec)	velocity measure-ment #3 (ft/sec)	Average velocity of #1-3 (ft/sec)	Segment Flow Velocity (ft/sec)	Segment Flow (cfs)	
1	4.2		0.00		0.00	0.00	0.00	0.00			edge of bank
2	5.0	0.8	0.60	0.30	0.51	0.47	0.42	0.47	0.23	0.06	
3	6.0	1.0	0.65	0.63	1.02	0.73	1.06	0.94	0.70	0.44	
4	7.0	1.0	0.80	0.73	0.49	0.50	0.49	0.49	0.72	0.52	
5	8.0	1.0	0.45	0.63	1.96	1.97	1.29	1.74	1.12	0.70	
6	9.0	1.0	0.40	0.43	2.07	1.90	2.03	2.00	1.87	0.79	
7	10.0	1.0	0.70	0.55	2.35	2.58	2.85	2.59	2.30	1.26	
8	11.0	1.0	1.30	1.00	2.30	2.18	2.16	2.21	2.40	2.40	
9	12.0	1.0	1.20	1.25	1.83	1.63	1.79	1.75	1.98	2.48	
10	13.0	1.0	1.15	1.18	1.41	1.65	1.57	1.54	1.65	1.93	
11	14.0	1.0	1.05	1.10	0.33	0.52	0.61	0.49	1.02	1.12	
12	15.0	1.0	0.75	0.90	1.09	0.89	1.01	1.00	0.74	0.67	
13	16.0	1.0	0.25	0.50	0.97	1.06	0.81	0.95	0.97	0.49	
14	17.0	1.0	0.60	0.43	0.87	1.04	0.82	0.91	0.93	0.39	
15	18.0	1.0	0.10	0.35	0.58	0.35	0.55	0.49	0.70	0.25	
16	19.0	1.0	0.35	0.23	0.12	0.08	0.17	0.12	0.31	0.07	
17	19.1	0.1	0.00	0.18	0.00	0.00	0.00	0.00	0.06	0.00	edge of bank

Total Flow (cfs):	13.56
Total Flow (gpm)	6088

Flow Calculation at Transect T-6

Shot Number	Distance (ft)	Segment Width (ft)	Depth (ft) at shot number	Average Segment Depth	velocity measure-ment #1 (ft/sec)	velocity measure-ment #2 (ft/sec)	velocity measure-ment #3 (ft/sec)	Average velocity of #1-3 (ft/sec)	Segment Flow Velocity (ft/sec)	Segment Flow (cfs)	
1	14.3		0.00		0.00	0.00	0.00	0.00			edge of bank
2	15.0	0.7	0.15	0.08	-0.37	-0.35	-0.34	-0.35	-0.18	-0.01	
3	16.5	1.5	0.00	0.08	0.00	0.00	0.00	0.00	-0.18	-0.02	
4	18.0	1.5	0.45	0.23	0.22	0.19	0.22	0.21	0.11	0.04	
5	19.5	1.5	0.40	0.43	0.59	0.47	0.41	0.49	0.35	0.22	
6	21.0	1.5	0.45	0.43	1.02	0.88	0.92	0.94	0.72	0.46	
7	22.5	1.5	0.20	0.33	0.69	0.69	0.20	0.53	0.73	0.36	
8	24.0	1.5	0.50	0.35	0.40	0.64	0.73	0.59	0.56	0.29	
9	25.5	1.5	0.80	0.65	1.58	1.64	1.45	1.56	1.07	1.05	
10	27.0	1.5	0.70	0.75	1.79	1.52	1.71	1.67	1.62	1.82	
11	28.5	1.5	0.50	0.60	1.24	1.79	1.50	1.51	1.59	1.43	
12	30.0	1.5	0.90	0.70	2.30	2.51	2.38	2.40	1.95	2.05	
13	31.5	1.5	0.75	0.83	1.87	1.87	1.64	1.79	2.10	2.59	
14	33.0	1.5	0.30	0.53	1.92	2.03	2.11	2.02	1.91	1.50	
15	34.5	1.5	0.60	0.45	0.04	0.34	-0.11	0.09	1.06	0.71	
16	36.0	1.5	0.60	0.60	0.23	0.31	0.12	0.22	0.16	0.14	
17	37.5	1.5	0.80	0.70	1.43	1.77	1.31	1.50	0.86	0.90	
18	39.0	1.5	0.60	0.70	0.02	-0.25	0.13	-0.03	0.74	0.77	
19	40.5	1.5	0.90	0.75	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	
20	42.0	1.5	0.75	0.83	1.01	1.12	1.38	1.17	0.57	0.71	
21	43.2	1.2	0.00	0.38	0.00	0.00	0.00	0.00	0.59	0.26	edge of bank

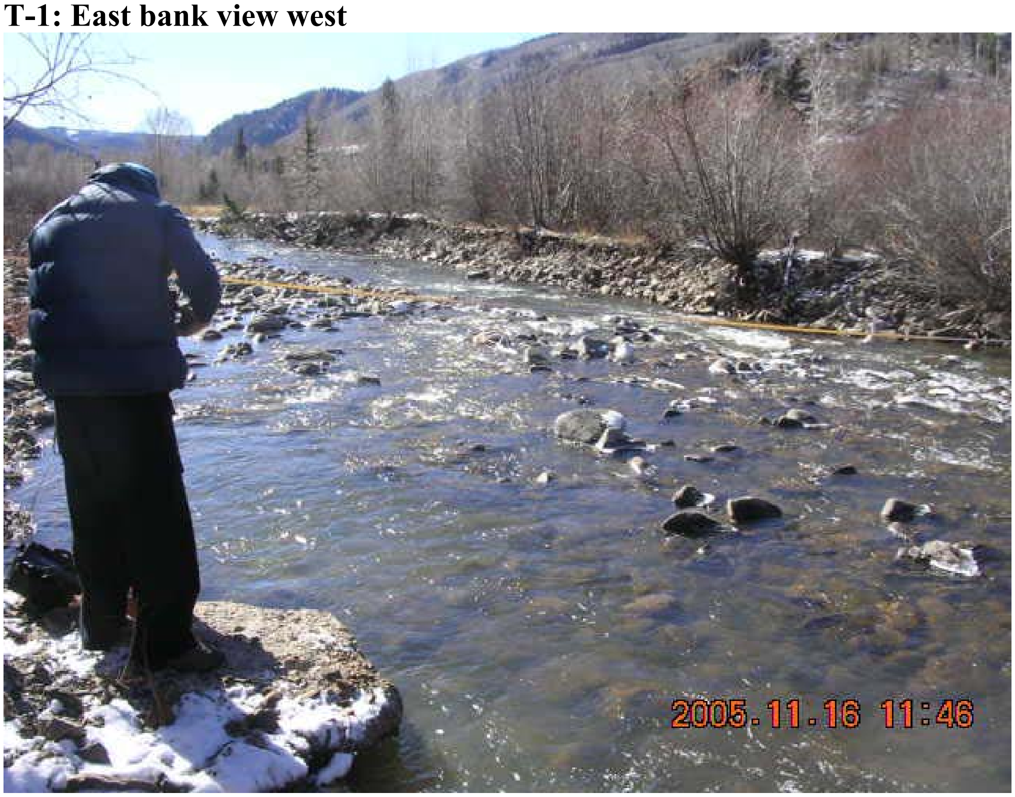
Total Flow (cfs):	15.24
Total Flow (gpm)	6841

Appendix A-3

Transect Photographs

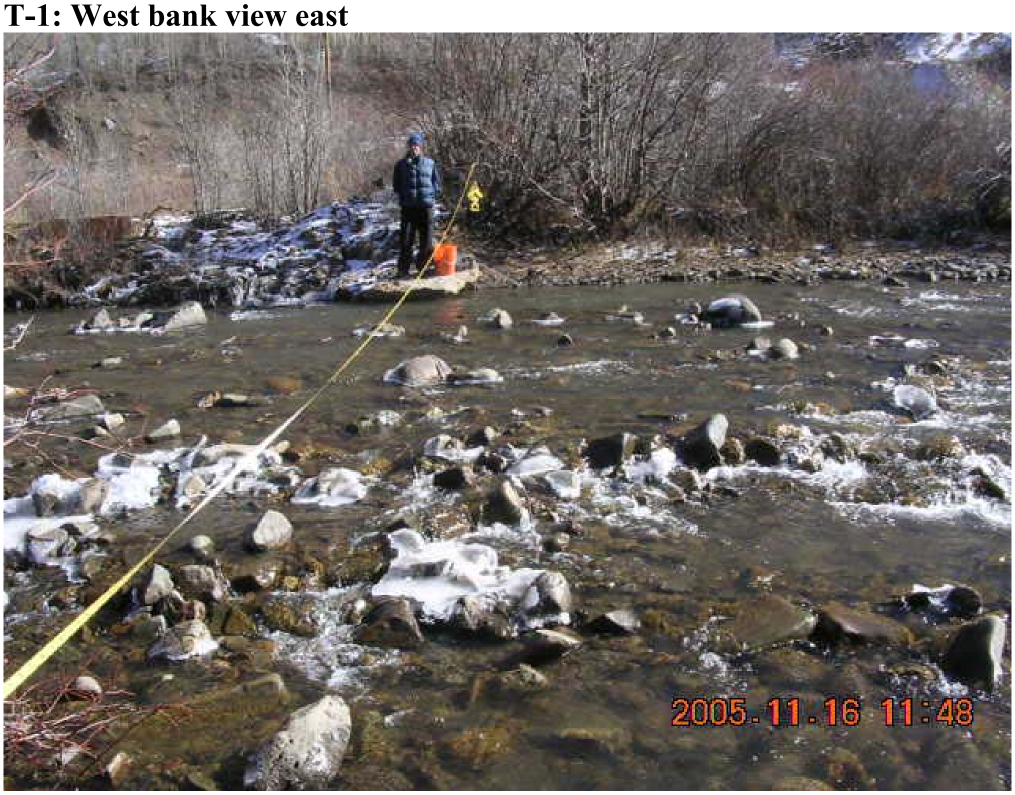
T-1: East bank view south

T-1: East bank view west



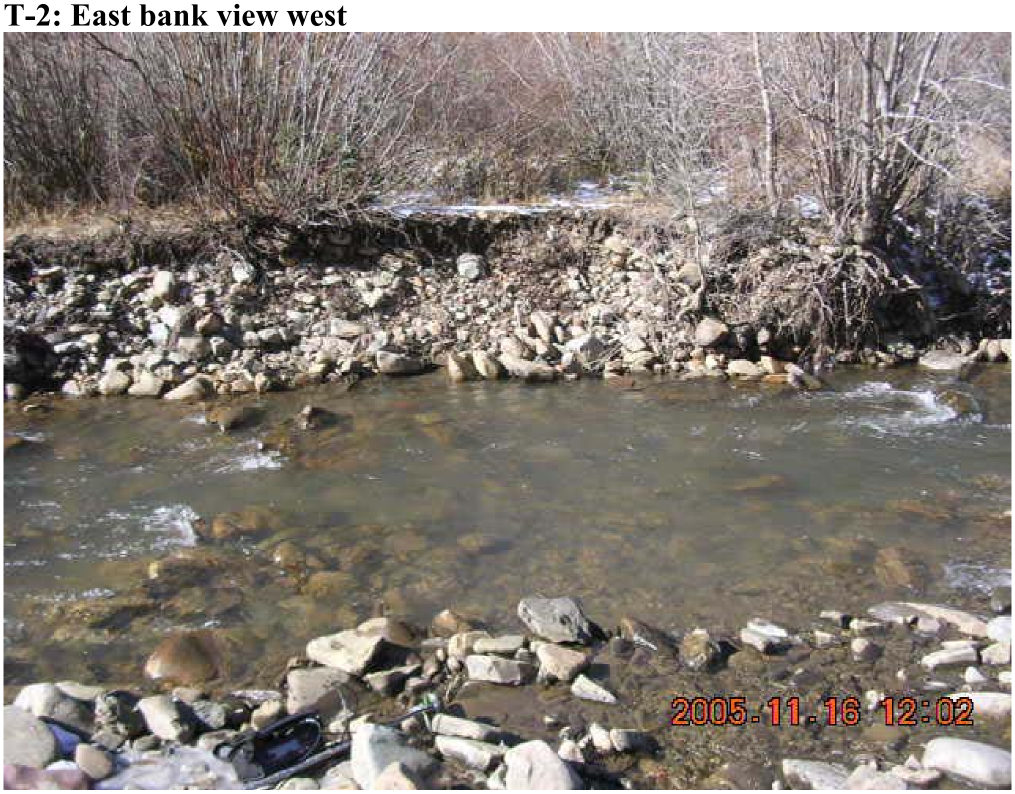
T-1: West bank view south

T-1: West bank view east



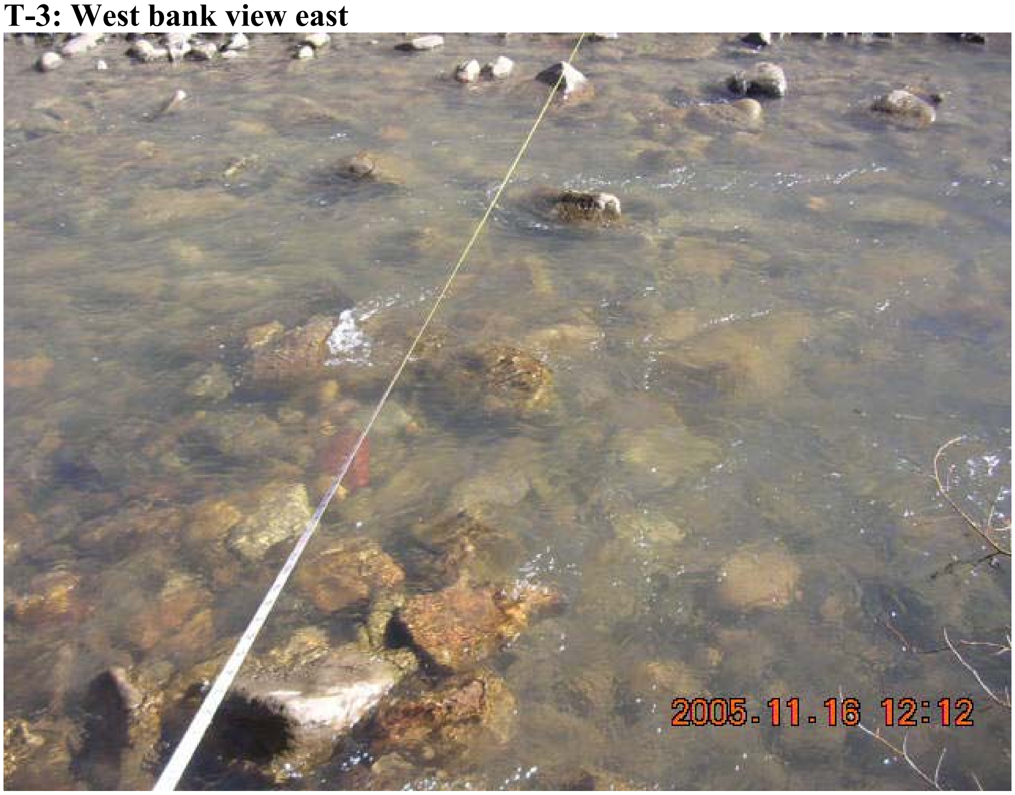
T-2: West bank view east

T-2: East bank view west



T-3: East bank view west

T-3: West bank view east

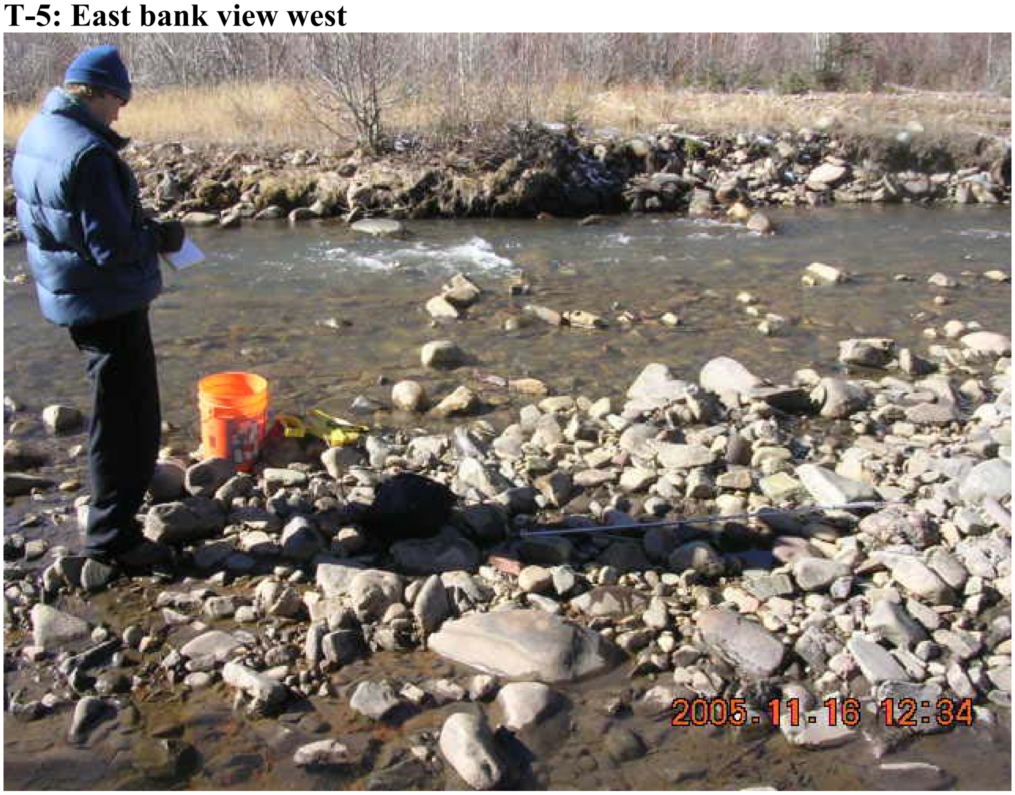


T-4: East bank view west

T-4: West bank view east

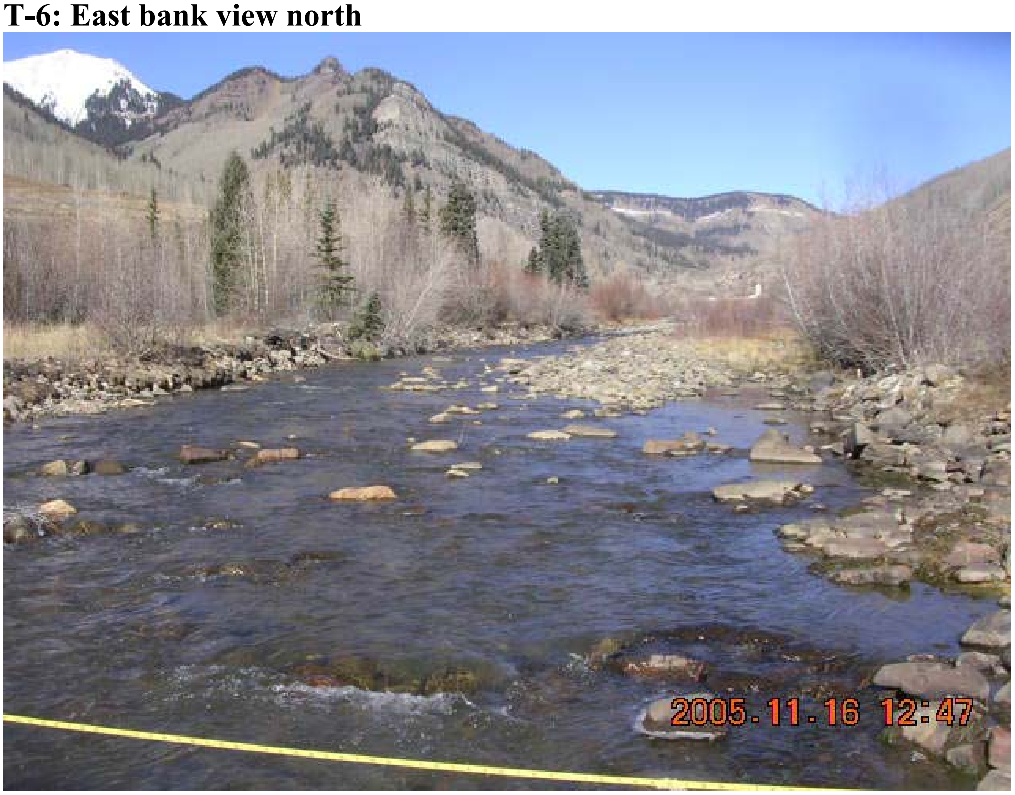
T-5: West bank view east

T-5: East bank view west

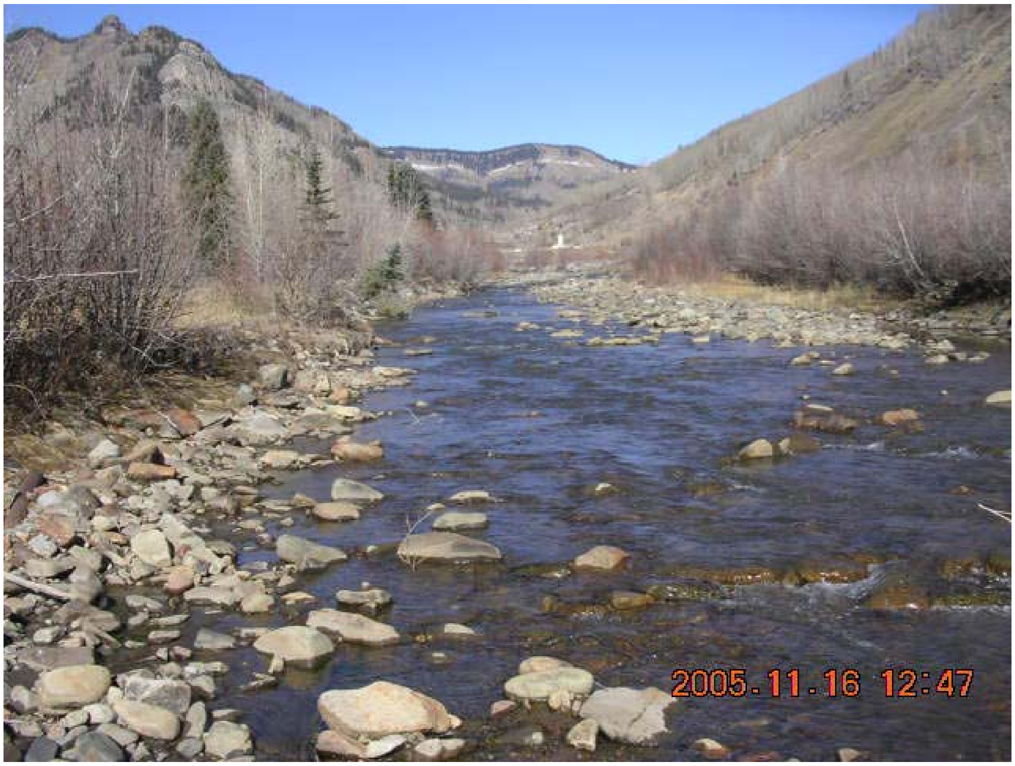


T-6: East bank view west

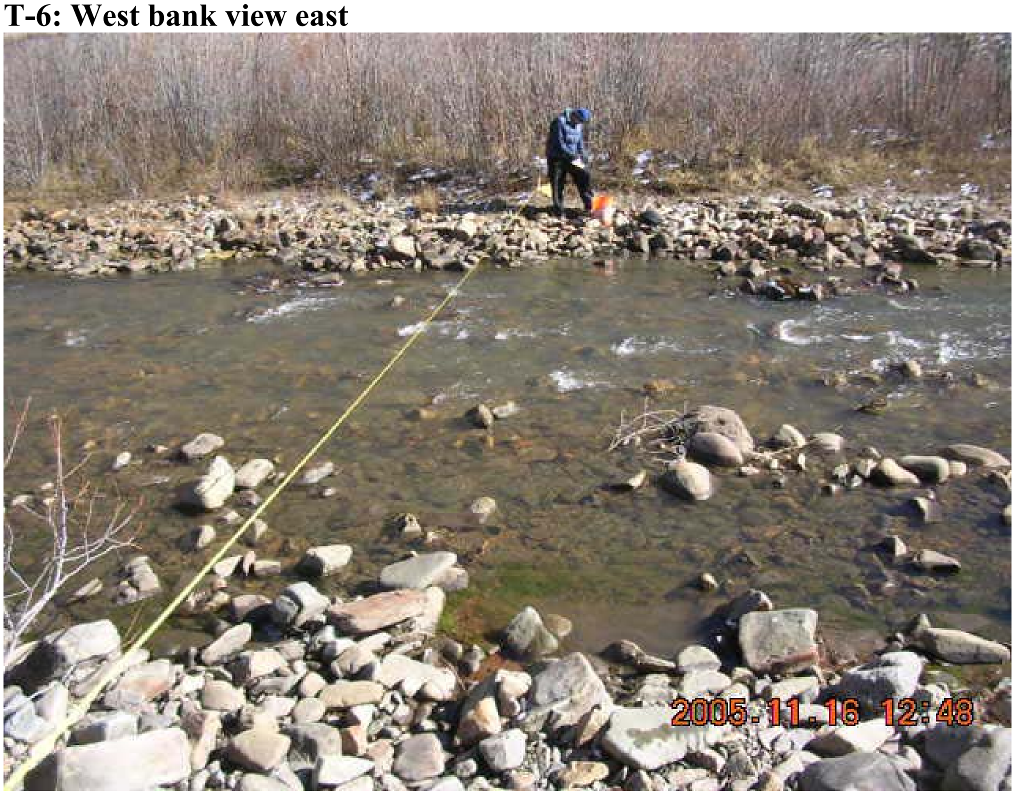
T-6: East bank view north



T-6: West bank view north



T-6: West bank view east



Appendix A-4

Transect Data

Evaluation at Transect T-1

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	5.5		0.00	edge of bank
2	6.0	0.5	0.20	
3	8.0	2.0	0.45	
4	10.0	2.0	0.45	
5	12.0	2.0	0.25	
6	14.0	2.0	0.40	
7	16.0	2.0		Shot No 1 through 15 excluded from mixing
8	18.0	2.0	0.10	zone due to where Ponds Discharge flow
9	20.0	2.0		enters at T-1 relative to island
10	22.0	2.0	0.35	
11	24.0	2.0		
12	26.0	2.0	0.10	
13	28.0	2.0	0.20	
14	30.0	2.0		Island
15	32.0	2.0		Island
16	**34.0**	**2.0**	**0.25**	
17	**36.0**	**2.0**	**0.50**	
18	**38.0**	**2.0**	**0.50**	
19	**40.0**	**2.0**	**0.10**	
20	**42.0**	**2.0**	**0.10**	Shot No 16 through 27 represent Low Flow
21	**44.0**	**2.0**	**0.20**	Channel alongside discharge
22	**46.0**	**2.0**	**0.20**	
23	**48.0**	**2.0**	**0.45**	
24	**50.0**	**2.0**	**0.60**	
25	**52.0**	**2.0**	**0.70**	
26	**54.0**	**2.0**	**0.15**	
27	**56.0**	**2.0**	**0.00**	edge of bank
		Ave Depth =	0.31	
Width =	22.0	Ave Depth =	0.31	use for transect width

Evaluation at Transect T-2

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	4.2		0.00	edge of bank
2	5.0	0.8	0.60	
3	6.0	1.0	0.65	
4	7.0	1.0	0.80	
5	8.0	1.0	0.45	
6	9.0	1.0	0.40	
7	10.0	1.0	0.70	
8	11.0	1.0	1.30	
9	12.0	1.0	1.20	
10	13.0	1.0	1.15	
11	14.0	1.0	1.05	
12	15.0	1.0	0.75	
13	16.0	1.0	0.25	
14	17.0	1.0	0.60	
15	18.0	1.0	0.10	
16	19.0	1.0	0.35	
17	19.1	0.1	0.00	edge of bank

Width = 14.8 Ave Depth = 0.65

Evaluation at Transect T-3

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	4.0		0.40	edge of bank
2	5.0	1.0	0.30	
3	6.0	1.0	0.20	
4	7.0	1.0	0.10	
5	8.0	1.0	0.20	
6	9.0	1.0	0.20	
7	10.0	1.0	1.00	
8	11.0	1.0	0.30	
9	12.0	1.0	0.50	
10	13.0	1.0	0.65	
11	14.0	1.0	0.80	
12	15.0	1.0	1.00	
13	16.0	1.0		Rock -1.0 ft assumed void of flow
14	17.0	1.0	0.10	
15	18.0	1.0	0.70	
16	19.0	1.0	1.25	
17	20.0	1.0	1.05	
18	21.0	1.0	0.75	
19	22.0	1.0	0.50	
20	23.0	1.0		Rock -1.0 ft assumed void of flow
21	24.0	1.0	0.70	
22	25.0	1.0	0.50	
23	26.0	1.0	0.70	
24	27.0	1.0	0.45	
25	28.0	1.0		Rock -1.0 ft assumed void of flow
26	29.0	1.0	0.30	
27	29.9	0.9	0.00	edge of bank

Width = 22.9 Ave Depth = 0.53

Evaluation at Transect T-4

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	3.7		0.00	edge of bank
2	4.0	0.3	0.35	
3	5.0	1.0	1.10	
4	6.0	1.0	1.35	
5	7.0	1.0	1.40	
6	8.0	1.0	1.30	
7	9.0	1.0	0.80	
8	10.0	1.0	1.20	
9	11.0	1.0	0.85	
10	12.0	1.0	0.80	
11	13.0	1.0	0.90	
12	14.0	1.0	0.90	
13	15.0	1.0	0.90	
14	16.0	1.0	0.80	
15	17.0	1.0	0.45	
16	18.0	1.0	0.60	
17	19.0	1.0	0.45	
18	20.0	1.0	0.40	
19	21.0	1.0	0.40	
20	22.0	1.0	0.60	
21	23.0	1.0	0.80	
22	24.0	1.0	0.50	
23	25.0	1.0	0.45	
24	26.0	1.0	0.20	
25	27.0	1.0	0.25	
26	28.0	1.0	0.00	
27	28.2	0.2	0.00	edge of bank

Width = 24.0 Ave Depth = 0.71

Evaluation at Transect T-5

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	5.4		0.00	
2	6.0	0.6	0.50	
3	7.0	1.0	0.80	
4	8.0	1.0	1.00	
5	9.0	1.0	1.35	
6	10.0	1.0	1.65	
7	11.0	1.0	1.50	
8	12.0	1.0	1.20	
9	13.0	1.0	0.90	
10	14.0	1.0	1.10	
11	15.0	1.0	0.60	
12	16.0	1.0	0.70	
13	17.0	1.0	0.60	
14	18.0	1.0	0.45	
15	19.0	1.0	0.55	
16	20.0	1.0	0.50	
17	21.0	1.0		Rock -1.0 ft assumed void of flow
18	22.0	1.0	0.25	
19	23.0	1.0	0.20	
20	24.0	1.0	0.15	
21	25.0	1.0	0.10	
22	26.0	1.0	0.30	
23	27.0	1.0	0.40	
24	28.0	1.0	0.10	
25	29.0	1.0	0.20	
26	29.8	0.8	0.00	

Width = 23.4 Ave Depth 0.60

Evaluation at Transect T-6

Shot Number	Distance (ft)	Distance btw shot numbers (ft)	Depth (ft) at shot number	
1	14.3		0.00	edge of bank
2	15.0	0.7	0.15	
3	16.5	1.5		Rock -1.5 ft assumed void of flow
4	18.0	1.5	0.45	
5	19.5	1.5	0.40	
6	21.0	1.5	0.45	
7	22.5	1.5	0.20	
8	24.0	1.5	0.50	
9	25.5	1.5	0.80	
10	27.0	1.5	0.70	
11	28.5	1.5	0.50	
12	30.0	1.5	0.90	
13	31.5	1.5	0.75	
14	33.0	1.5	0.30	
15	34.5	1.5	0.60	
16	36.0	1.5	0.60	
17	37.5	1.5	0.80	
18	39.0	1.5	0.60	
19	40.5	1.5	0.90	
20	42.0	1.5	0.75	
21	43.2	1.2	0.00	edge of bank

Width = 26.7 Ave Depth = 0.54

Atlantic Richfield, Rico Mine
Colorado Discharge Permit System Application

Attachment 17

Current and anticipated land access/ownership status

The St. Louis water treatment system facilities, including the wastewater treatment plant, settling ponds and associated solid waste management repositories, will be constructed and operated on parcels of land that currently include a mix of privately owned patented lode and placer claims, and U.S. Forest Service owned National Forest System lands located within San Juan National Forest. Atlantic Richfield will arrange for acquisition of the necessary private patent claims or portions thereof from their present owners, and certain essential San Juan National Forest tracts from the Forest Service pursuant to the Small Tracts Act. The acquired lands will be consolidated into larger parcels and transferred into a trust to accommodate the plant, ponds and repositories. Atlantic Richfield will own and be responsible for operation of the constructed treatment system. The water treatment system facilities will be accessed using an existing road that currently is subject to a Forest Service Road Use Permit held by the Applicant. Upon consolidation and transfer of the subject lands to the trust, Atlantic Richfield will control use of the road to prevent interference with operation of the water treatment system.